SCHOOL SCIENCE AND MATHEMATICS

VOL. XIV, NO. 8 NOVEMBER, 1914 WHOLE NO. 118

THE UNFITTING OF THE PUBLIC SCHOOLS.

BY HERBERT F. ROBERTS,

Kansas State Agricultural College, Manhattan, Kansas.

"The common school prepares for the high school, the high school for the college, the college for 'Who's Who.'"—J. McKeen Cattell.

The writer is not a "school man," but a person who by dint of fifteen years of handling the "product" of the public schools in biological courses in college, has had some opportunity for observation. By the same token, as the sympathetic parent of children he feels a special sense of joy in taking up the cudgels, since the cause is the cause of childhood in general. Finally, as a citizen and a tax payer in his community, he claims the ordinary layman's privilege of speaking his mind. Furthermore, the writer is a friend of, and an unqualified believer in, and supporter of, the public schools.

What ought the public schools to be and to do? It would seem almost axiomatic to say, that the public schools ought to train, first, the body as a whole; second, the special senses of the body; third, the power of independent reasoning; and, fourth, they should train the will.

Going at it from the standpoint of biology, one would say that the very first duty of the human animal is to teach his young how to manage to survive in a physical way; how to fend for himself in emergencies; to train him, in a word, to be handy and skillful and quick and cunning in the use of his muscles, and in doing the things that—to use the jargon of the biologists—have "survival value." In order to enjoy life, you have to survive, to say the very least.

Now that is precisely what the wild Indian, when he was once wild, did for his offspring, and what the uncombed wild men still left in the various outlying spots and unclothed islands of the earth, do for theirs.

How to swim and hunt and fish and handle weapons, how to make fire with the fire sticks, how to know directions and the

"sign" of things in the forest; how to sense the weather changes and travel by the stars; all the wood craft, water craft, and air craft that savage man has to know in order to get his daily food, to escape from or to destroy his enemies, and to outlive the various accidents of his existence, constitute the education of the young of primitive man. This bodily skill was likewise a part of the training of the pioneer boys and girls in America, and out of it came a race of resourceful, reliant, bold and adventurous men and women.

Now civilized man has lessened the precariousness of life in some ways, and has exaggerated it in others. Food, except in the earning of it, is no longer such an uncertain thing.

Our enemies take it out on us in subtler ways than aforetime. They no longer waylay us in forest paths, with kris or bolo or club, in order joyously to return home with our heads to adorn their dwellings, or perchance to relinquish their own to a similar destiny. We have more or less mechanically subdued nature. We have built bridges and roads over the treacherous, precarious places where we have to travel, and we have eliminated around most of our homes, almost all the wild beasts above the level of the bacterium, except the mouse and the English sparrow.

But we have railroads that destroy us, ships that drown us, automobiles that run us down, huge factory buildings and hotels and theatres in which we are caught like rats and burned to death —a thousand and one dangers and contagions of city life, that offset every one that savage man had to encounter. Everywhere in town or afield, common accidents await us unexpectedly in the midst of so-called "civilized" surroundings. A knowledge therefore of how to meet these accidents, and of how to help others involved in them, is one of the primary needs of man. To know how to make scientific bandages for any injured part of the body, to improvise splints for broken limbs, to resuscitate drowned or asphyxiated persons, what antidotes to use for common cases of poisoning—these, and a hundred other kinds of first aid knowledge that affect life directly, should be taught to all children everywhere in the schools. There is just as fundamental a need for training in survival-craft today as there ever was, and where is it being taught? Not in the homes, because most of us don't know how to teach it ourselves, and we would not have time to teach it if we did. Certainly survival-craft, fending for oneself, and first-aid knowledge and practice, are not a part of the "curriculum" of the schools.

There is just one solitary place where your boy and mine can get today this kind of real fundamental training which teaches him how to be a man, how to take care of himself and others in emergencies, and that, as you know, is absolutely *not* in the public schools *at all*. It is in the organization of the Boy Scouts. Personally, from my own observation of its effectiveness, I would not trade one solid good year of Boy Scout lore and Boy Scout training *under a first class scoutmaster*, for any three years of any public school system under the sun that I have ever seen.

Contrast the method of the Scouts, for example, with the method of the schools. One is dynamic, the other static. The one develops to the maximum, encourages, indeed *forces*, initiative; the other glorifies military subservience to routine. The one not merely asks but *demands* originality and resourcefulness. The other requires uniformity at all costs, and exalts, above individual expression, the ideal of "discipline" and "order." The one forces the boy to hammer himself out into something individual; the other hammers the individuality out of the boy. This pride in uniformity of performance in our public schools amounts almost to a mania. I know of schools where there is published annually what is known as an "honor roll." And what names, pray you, appear upon this "honor roll." *The names of those pupils (save the mark), who have never been tardy or absent!* Well and good. Punctuality is a righteous virtue as far as it goes. But the merest clerk who punches the time clock in a department store has this virtue, although he may do nothing more original all day long than to run a tabulator. For one, I should like to see a school publish an honor roll consisting of the names of those children, who, during the year, had produced, made, or done, the most original and at the same time the most useful or helpful thing. Punctuality should be a matter of course, like dressing or eating. If any virtue is to be exalted, let it be not the negative virtue of dull conformity to type in behavior, but that of creativeness, of originality, of inspiration.

The sole, solitary hope of any human being amounting to anything in this world lies, first, in his finding out just exactly what he, personally and individually, is best qualified to do, and, second, in finding a motive and a stimulus during his growing years, to be and to do that thing.

Education, in other words, consists in giving every individual a chance to test and to try out his powers in enough directions to

be able to get a point of view, and to acquire such an experience as will enable him to choose intelligently for himself that which he finds himself best fitted by nature to do. Now is that what we are doing for the children in our public schools? Nothing whatever of the sort.

We adults, ourselves mistrained, organize what from our standpoint, is a standard school "curriculum." Such and such things must go in, so much number work, so much language, so much science or nature study, so much drawing and music. We carefully snip off with our shears, sections of this cut-and-dried program, and paste them on the doors of various cells called "grades." Into these cells the prisoners are marched, and there they are forced by teacher and principal and superintendent and parent and janitor and truant officer to sit all day long—sit, mind you, from 9:00 a. m. to 12:00 and from 1:30 p. m. until 4:00 in absolute physical inactivity, except for occasional imbecile "calesthenics"; to sit, fifty of them in rows together, in these round-shoulder factories of school desks all day long, except for a total half hour or so of "recess."

This utter neglect of the physical body is one of the most serious indictments I know of against our present public school régime. Children are treated as though they had no bodies. Kept for the most part in poorly ventilated rooms, overheated with dessicated air, forced to sit, immobile, with relaxed muscles, in the abominable school desk, for the greater portion of each day, what wonder that physical deterioration is such a frequent accompaniment of "schooling." Round shoulders, narrow chests, and spindle legs, are a dear price to pay for the precious stuffing and cramming with memorized data, that constitutes most of the so-called education of the schools.[1]

It was said at the outset that the very first duty of the public school is to train the body. Yet where is it being done? To be sure, medical examination and treatment for adenoids, defective teeth and deficient eye-sight and hearing, is a function of some of our public schools. But this does not go far enough. Every child in the public schools should receive physical training sufficient to correct inevitable structural defects, to build up a symmetrical, strong, and well formed body, and to keep the organism in good physical tone. This can only be done satisfactorily where a gymnasium indoors, with swimming pool and shower baths, and

[1]See "The Effects of School Life upon the Nutritive Processes, Health and the Composition of the Blood," by Lewis M. Tennan, Pop., Sci. Monthly, Vol. 84, March, 1914.

proper playground apparatus out of doors, are available to every school child. Furthermore, the gymnasium and play hour should be for the full class period of forty-five minutes, and should constitute a regular portion of every day's program. If any standpatter in school administration urges that such an idea is Utopian and impractical, the answer is that it is already an accomplished fact. There already exist in America today, a few school systems where gymnasiums and swimming pools for boys and girls are found in each and every building in the system, and where physical training and daily exercises and daily cleanliness are as much a part of the education of the children as they used to be among the ancient Greeks, for example.

Having crowded our little prisoners into their cells, and having them firmly wedged into their comfortable seats, according to the time-honored and sacro-sanct system of the day, what do we proceed to do with their time? We occupy it with the administration of our "curriculum." Just what is this "curriculum?" We as parents are interested to know. We no longer have our children. We no longer are permitted to live with them. We simply have them in to board. *They live in the school.* It is, therefore, a vital matter to us to know just how their life is spent. Let us go to an average school room and watch the proceedings. Sitting in rigid rows in military order, some fifty children are "getting" and "reciting" their "lessons." Down their passive throats, a strained, nervous, overworked woman is engaged all day long in jamming formal arithmetic, formal grammar, formal reading and writing and spelling, paper geography and paper history—all or nearly all memory work—not for the sake of any earthly *motive* under the shining sun, but just because these things, in and of themselves, are generally supposed to constitute an "education."

Now is all of this absolutely necessary for all children? Dr. J. McKeen Cattell says in a recent address:

> "Children must learn to read, write and calculate, but under proper conditions of family and society, schools to teach these tricks would be nearly as superfluous as schools to teach infants to walk and talk."

Why, therefore, in Heaven's name, where parents do exist who are sufficiently intelligent, and sufficiently willing to make their children acquainted with these necessary tricks at home, cannot the stubborn, inflexible school program be modified to suit? Why cannot children "elect" as in college, the subjects that it is really necessary for them to take in the schools, and, omitting the others,

occupy their time more profitably under their parents' direction? Why must it be the whole loaf or no bread; why this perpetual requirement of an absolutely wooden conformity of all pupils—even of those who do not need it, to a program that may be necessary for others?

As an actual matter of fact, reading, writing, spelling and calculating, are not absolutely sacred arts. They are not necessary to the development of judgment, of the will, of character, of vision or of spiritual insight. Indeed, with the stress which the school routine lays upon the execution of the endless details of the three "R's" and their appurtenances, the great realities of life are generally smothered out of the child's mind altogether. They are useful and valued tools—nothing more; but our schools have made the blunder of elevating their possession into an end in itself.

Bacon says, "Reading maketh a full man," and for empty men who have no other filling and know not where or how to get it, reading is an excellent substitute. It is the best substitute for thinking that has ever been invented, because it now fills the empty mind with something somebody else has said. One shudders to think of the fate of the unthinking in past ages, doomed for a little time to walk the earth, without the perpetual litter of newspapers and the cheap popular magazines and books, by the unthinking perusal and absorption of which, they can now fill the otherwise empty hours.

In our ideal, well managed school, the pupils must not only remain impounded in their rooms, they must not only stay implanted in their seats, but they must not "whisper," they must not "laugh," they must not "pass notes" or make signs of any sort, kind, or character, to demonstrate they are alive. They must sit "in position" without moving from seat to seat to observe, compare, comment upon, or criticise one another's work. That would involve "disorder." And if there is anything that our juvenile jail—I mean our public school—particularly prides, preens and plumes itself upon, it is its "discipline." Discipline of what? Of the soul? No, for the little souls go out of the windows and away over the fields, to the woods and the streams, to the streets and the parks; they are dreaming of the days of freedom, when the school closes for three glorious months. The souls of the more intelligent children are engaged in one unending protest, most pathetic because of their not understanding how to protest or why, against this unnatural, artificial, meaningless and sense-

less "discipline." Some of the bolder spirits indeed, bursting into open rebellion, deliver themselves over to the freedom of the streets, and these are the "bad boys" of our model school.

What is discipline anyway? Does it consist in standing in a row in a certain mechanical attitude while a roll is being called? Does it consist in the mechanical, uniform, and exactly similar execution of commands imposed from without, and automatically and unthinkingly obeyed? This is the military idea and ideal of "discipline," and this idea and ideal the so-called "best" of our public schools get as much of as they can hold.

But this is not discipline. Discipline is the perfect response of the body to the soul's commands, and it begins and ends in the individual himself. It is never imposed from without. How is this discipline obtained and attained to? By practising the body in the execution of the soul's commands, and not otherwise. It is a dynamic and not a passive process. How can it be acquired? *By doing things in which the motive for the doing is so strong that the soul finds it easy to make the body obey.* But the motive may lead in destructive directions, may lead to physical and spiritual disintegration; so the business of education and of the educator is to furnish a sufficient number of right, i. e., useful and beneficial and constructive motives, to lead the soul to enact its bodily life along constructive, integrating lines, instead of along destructive, disintegrating lines. That is all there is to it. Give a child sufficient motive for the things it is going to do, *and the very doing itself will be the discipline.* Then you can tear up the jail seats, and put tables and chairs around the room in happy and natural and home-like irregularity, as in the Montessori "Houses of Childhood," and a group of contented children will be found doing joyous self-imposed tasks, freely, willingly and intelligently.

This is the essence, the principle, the spirit, for example, of the method of Dr. Montessori. Of course there are poor literal souls, who imagine the Montessori contribution to education to consist in just these "insets," and just those "sandpaper letters," and just all the other "apparatus." Nothing at all of the sort. The apparatus is but some particular mode of expressing some particular working of the mind. Not for the sake of its contribution to the technique of education, but for its spirit, I wish that every parent, every teacher and especially every school superintendent and school board trustee throughout this land could be compelled to read Dr. Montessori's own book ***through***, and

forever to engrave upon his memory, this one guiding principle in building up a school—of what the author calls *"the liberty manifestations."*

As it is now, for the most part, our public school "education," so-called, is largely an extraneous imposition of artificial tasks, a grafting on of ideas from without, a plastering and veneering of facts arbitrarily chosen to represent a conventional notion of what constitutes an "education."

The real "education" when we ever get to it, will consist first in a mastering of the *Senses,* second, in a training of the *Power of Independent Reasoning,* and, third, in a training and mastery of the *Will.*

Now, except incidentally, accidentally and peradventure, our public school "system" does not train the Will at all, because its whole business is to subvert it, and to substitute for it the will of the teacher, and the collective will of the community that is conspiring to force the child to do things which it can find neither motive for, nor reason in doing.

Our public school system does not train the senses at all. It simply and utterly neglects them. How many public schools have exercises in the training of the power of vision, for example; of seeing discriminately, and of distinguishing objects, situated at varying distances, and separated by different intervals of space from one another; of distinguishing accurately and discriminatingly between delicate tints and shades of color; of distinguishing accurately, fine differences in qualities of touch, taste, and smell? How many of our public schools train the pupils to discriminate accurately) differences in pitch and intensity of sound? The nearest we come to this is in our perfunctory public school music, the chief function of which is to teach the pupils to "read notes," but not to develop a fine ear sense or a fine discrimination amongst sounds. Suppose we were deliberately to set about the training of the senses *per se.* Can anyone doubt that it could be done? Does anyone suppose for a moment that it would be impossible to place in every school room a set of exercises in vision, hearing, touch, taste, and smell that would be of the utmost value in developing the special senses to a point of efficiency which we seldom see attained? Would not active practice for an hour or two a day in such direct and purposive development of the acuteness and sensitiveness of the special senses, be of infinitely more value than the routine memory drill which it would ordinarily replace? When we stop to think that

absolutely all we know of this universe, we learn through our senses, and that absolutely all progress in the mastery of the physical world is through sense training, the practical utility of going to work scientifically at sensory training in early childhood becomes too apparent for dispute.

Suppose in music, for example, we were to introduce not only exercises in the determination of pitch, and exercises in sound intensity, developing the ability of children to detect and distinguish notes of different pitch rendered at different intensities, but suppose we were to add practice in the discrimination of overtones, in detecting *quality* in sound. Suppose in addition to the ordinary study of melody, one were to take a carefully selected series of orchestral and concert instruments for example, and suppose one were to call upon the pupils to summon up their ears, to listen for the overtones, and to describe the qualities of one or more of these instruments. Then suppose one were to take them to the school auditorium to hear an orchestra, and were to train them to select, to distinguish, and to listen singly to each of the different types of instruments used—just what the musician can do and does do—would this not only develop an ear sense that would go to the core of musical understanding and appreciation, but would it not also build up a general mental alertness and awareness that we seldom see realized? I suppose the pupils could be taken after such a course, into the woods and the meadows, and be set at work to listen for, to discover, and to describe the greatest possible number and their qualities, of sounds, from the faintest to the loudest, made by the many insects, the various kinds of birds, and the other factors in the environment.

One could go on indefinitely in a discussion of the sense of richness and glory in the world, to say nothing of the increase in actual knowledge, that would develop by a high training of this sort of all the special senses, of sight, hearing, taste, smell, and touch.

Can anyone doubt that if the time now devoted by the schools to mere memory exercises, the routine repetition of that which is supposed to store the mind with the thoughts of the ages, were devoted to the stimulation of *new* thoughts, to the independent training of the *Will* and of the *Sense Organs* of the children, that the world would have better artisans, better artists, better scientific investigators, and fuller, and richer, and more successful lives?

As to the development of the Power of Independent Reasoning, herein the public school mind has rested as in its citadel. At all events, the public schools, as they are, and bad as they are, are supposed to develop reason, through mathematics and through the study of the sciences.

As a matter of fact, however, the pressure of a senselessly overloaded program, with a certain number of pages in a certain ill-starred book to be "finished" by the desperate teacher in a certain grade during the term, generally prevents absolutely any attempt at reasoning in mathematics, and resolves it into a miserable effort on the part of the child to scramble through numberless "problems," often during night hours when he should be asleep in bed, and finally, perhaps, with the coaching of the parents, in order that the luckless little wight may not "get behind in his class," and finally—idiotic word—"fail."

Then as to the sciences; anyone who has been compelled to watch the conduct of average school courses in the biological sciences, and who realizes how perfectly a cut-and-dried, stereotyped routine of drawing type forms, and of committing organs to memory, is involved in much ordinary present-day teaching of biology in high schools, will not entertain very much hope for what is done in the grades, unless perchance the nature-study teacher be sufficiently untrained according to standardized ideas, and at the same time sufficiently intelligent, fresh and eager, to have a real child-like naturalist's curiosity about the living creatures. If so, there is then some hope that she and the children will together explore and lose themselves delightfully in Nature's wonderland. Any college instructor in a biological subject will bear abundant witness to the helplessness of the average public school boy and girl, brought into contact with plants or animals for study. There is evident in them little or none of the fresh vivid interest and curiosity that we see in little children, whose senses are still unspoiled by the school sterilization process.

As the case stands at present, our public schools, as ordinarily operating are, biologically speaking, unfitting their victims for life. Twelve years of the average public school régime, with its artificialities, its senseless "discipline," its sterilization of the senses, and its paralysis of the will, turns out a product capable of little or no creative work; a conventionalized and imitative, rather than a free and original personality.

Originality has too often been stamped out, and initiative has "petered out." The power to sense and to know and to feel the

living world, and to think and reason independently on data gathered by oneself and at first hand—this power has been forever lost, and worst, and most tragic and pitiful of all, a thousand and one possibilities of development with which the plastic, willing, curious, investigating, doing, child mind entered the school jail, have been stifled, sterilized, and aborted; or else they have been perverted and diverted, until he finally emerges a mental cripple, leaning on blackboard, and textbook, and note book, and teacher; victim of the "schedule," the "outline" and the "curriculum." He emerges into a world, for life in which he is absolutely and totally unprepared, because for twelve years he has not lived at all nor realized nor developed his personality. He has not "found himself"; he has not created anything; he has simply passively conformed to a "course of study."

The writer realizes that there are zealous school reformers here and there, whose schools are actually leading out along the true lines of sound human biology, but taken by and large, the country over, despite the perfection of fine buildings, of the smoothly working, machine-like regularity and order of the "system" of our "best" schools everywhere, there lies almost invariably and infallibly the three-fold indictment that the public schools fail to train the Special Senses of man, that they fail to train the Power of Independent Reasoning in man; and that they fail to train the Will of man.

So much for destructive criticism. What can be done?

In the first place, let us abolish the lock step of the grades. Let the pupils advance by subjects and not "pass" by grades. Let us introduce departmental teaching throughout, down to and including the first grade. This will serve the double purpose of furnishing expert teaching in the various subjects, and of allowing the children to move about from room to room, and get the variety and change they need. Let us introduce handwork *throughout* the grades, adapted to the two sexes and to the various ages, and so arrange the program that the hours of class work and handwork and the recreation hours may follow one another in close enough sequence to prevent monotony. Children's minds are not adapted to long, monotonous tasks of any kind. Let us diminish the number of pupils in a room, break up the jail seats, and introduce at least the spirit of Dr. Montessori's method for securing independent work. Let us treat the children as we would treat them in our homes, not as little convicts "doing time." Since pedagogues always have to "stress" something

(they never "emphasize" or "accentuate"—they always "stress") —then let us "stress" the training of the special senses, the development of the power of reason, and the development of the will. Let no one think for a moment that exercises have not been worked out, directed straight toward these three special kinds of development. They have.

Let us build up the physical body of the child as religiously and as carefully as we would build up his mind. To do this our school needs an equipment that few schools have. And finally, do not think that every child must necessarily live the whole of every day in our school. If there are parents who can do more for their children along certain lines of his development than the school can, let them do it, and let their children come to the school for those things alone that their parents cannot give them.

Finally, as to the teachers. No one can question for a moment the faithfulness, self-sacrifice and devotion to duty of the vast majority of our public school teachers. Most of them are women, usually underpaid and overworked, and often mistreated by political scalawags who contrive to get on so-called "boards of education," and by the occasional specimens of the same type of gentry who sometimes get into the superior positions in the school system. None of the strictures in this article therefore are intended to reflect upon the teaching force, except in so far as they, the administrative officers, and ourselves, the public, are in common to blame for false standards in education, and for a wholly artificial and biologically unsound system.

The remedy, so far as the teaching force is concerned, seems to lie in the future, and from the writer's point of view, the chief remedy lies in a frank recognition that teaching is a biological business. Children are young animals—young vertebrates, primates to be sure, but still young animals. Their training is a biological problem, for the handling of which biological training is necessary. At the present time, any person may become a teacher in the schools, with absolutely no biological training whatsoever, except for a little "human physiology." This should not be. The teachers of the future should be trained, well trained, as a foundation, in general biology, especially in zoölogy, and on this foundation should follow special training in human biology. Given the other requisite characteristics, a trained biologist should make the best trainer of the young human animal. In this connection, it should be remembered that Maria Montessori, whose ideas and methods are having such influence on our pedagogy, is a doctor of medicine as well as an experimental psychologist.

To obtain teachers adequately trained, we shall have to pay good salaries, and guarantee tenure of office; and finally the state will have to provide a retiring pension system. If we ever get our schools out of personal, peanut politics, and established on a civil service basis, with stability of tenure and honorable reward for long and faithful service, we shall begin to actually realize some of the latent possibilities in the human race, that our present slipshod, shoddy, and superficial system, fails even to approximate.

Here and there a bright light is breaking on the public school horizon in America. For example, the vocational public schools of Gary, Indiana, under the leadership of a creative idealist of massive practicality, are sending out waves of radiant energy, that are breaking into the peripheral sense organs of some of our leaders in public school education. Here again, as in the Montessori schools, it is the spirit that must lead and not the mechanism, not the machinery, not the apparatus, not the program, not the "curriculum." The spirit alone must lead, by various routes and in various guises, but always to one development as a goal, to the largest possible freedom, the largest possible opportunity, and the largest possible usefulness of each individual child.

COURSE IN ADVANCED CALCULUS.

The attention of high school teachers of mathematics in Chicago and its suburbs is again called to the course in advanced calculus offered in University College during the coming autumn and winter quarters by Dr. E. J. Wilczynski. This is so unusual an opportunity that no one interested in mathematics who has not had this work should neglect to take advantage of it. Dr. Wilczynski possesses exceptional teaching ability. His scholarship combined with this power makes his courses a delight and an inspiration. No teacher interested in his subject and in his own development can afford to miss this chance to do graduate work under such a man.

The time of meeting will probably be arranged to suit the convenience of the class. Details with time and place of first meeting can be secured by addressing Registrar of University College, University of Chicago.

SCIENCE WORK IN PARISIAN SCHOOLS.

By Frank S. Baker,
High School, Yonkers, N. Y.

In Paris there are two types of schools that may be considered wholly or in part secondary: the Primaires Supérieures, such as Arago, Colbert, Lavoisier, and the Lycées, such as Saint Louis, Henry IV., Charlemagne or Condorcet, etc. For girls there are separate schools of each kind having quite different courses. I shall consider here only those for boys.

The aim of the Primaires Supérieures schools is to prepare directly for the industries or for the higher professional and industrial schools of which there are many in the city. Entrance to these schools is obtained by competition among graduates of the elementary schools when the boys are about 14 years of age. The course is of three and sometimes four years' duration. The first year all pupils study the same subjects, but thereafter they are separated into classes for special instruction along the lines which they are to follow. The following table shows the subjects studied and the hours devoted to each during the first year:

Morals	1
French	5
Modern languages (English, German)	3
History (French)	1
Geography	1
Mathematics	4
Sciences (physical and natural)	3
Design and modeling	3
Writing	1
Singing	2
Practical exercises (shop work, etc.)	4
Gymnastics (during exercise)	2
Total	28

During the second and third years the time allotted to the study of languages and mathematics is reduced and the time for special practical exercises increased, so that on the average there are thirty-one hours of work per week, of which only three are given to elementary sciences as such. These three hours are divided about equally between physics, chemistry and biology with a little geology. Laboratory work is done only in chemistry. One period a week is required in industrial chemistry for those taking

industrial and agricultural courses and several periods a week are offered in the extra fourth year that is found in some of the schools, to those preparing for the School of Physics and Chemistry.

Examination of the official syllabus shows that during three years, the amount covered in physics, with the exception of the laboratory work, is about the same as that offered by the high schools of New York state. The chemistry work is inclined towards the needs of industry and the third year is given almost entirely to inorganic chemistry. In zoölogy and botany the course is general. In the absence of laboratories the work is done largely from models, charts and texts. Geology, beginning in the second year, is rather historical but becomes more practical during the third year when special attention is paid to the applications to mining, public works and agriculture.

The Primaires Supérieures schools are well equipped with demonstration apparatus. The teachers are well prepared and for the most part enthusiastic. All of them deprecated the lack of modern laboratories and laboratory methods and some expressed the hope that in the near future that side of science work in their schools would be much improved. The classes were generally too large for the highest teaching efficiency. The continuation of the work in each science during the whole course gives excellent opportunity for correlation and repeated reviewing.

The Lycées provide a continuous course of study for pupils from 9 to 18 years of age and so may not be considered entirely secondary. The tuition is rather high and consequently the children of the more well-to-do parents are found here. The aim of the Lycées is to prepare for the universities and military schools and to give a broad education to those who will not continue their education further.

The nine year course is divided into three parts; two years elementary course, four years of the first cycle and three years of the second cycle. During the first cycle there are two classes, one composed of those who study Latin and Greek and the other of those who study modern languages and sciences in place of the ancient languages. In the second cycle, which includes the last three years, there are four sections: Greek-Latin, Latin-Language, Latin-Science, and Science-Language. Some Lycées make specialties of certain sections as Lycée Saint Louis which is particularly scientific, offering only the Latin-Science and the Science-Language courses in the second cycle.

In the last class of the first cycle the subjects studied and the time allowed for each are as follows:

	Classical	Scientific
Morals	1	1
French	4	5
Latin	6	
Greek	3 elective	
Modern Languages	5	5
History and Geography	3	3
Mathematics	3	4
Physics and Chemistry		2
Natural Sciences		1
Drawing	2	3
Bookkeeping		1
Total	24+3	25

This table shows that three hours out of twenty-five or twelve per cent of the time is spent in science courses. During the four years of the first cycle the pupil in the science section will have five hours of natural sciences and four of physical sciences or nine science hours out of 91 hours work—10%, while the non-scientific course offers three hours natural science out of a total of 99 hours or about three per cent.

In the second cycle the following program is offered:

CLASS OF MATHEMATICS AND PHILOSOPHY.

	Philosophy	Mathematics
Philosophy	8-½	3
Greek-Latin	4 elective	
Latin	2 elective	2 elective
Modern languages	3	3
History and Geography	3-½	3-½
Mathematics	2 elective	8
Cosmography	½	
Physics and Chemistry	5	5
Natural sciences	2	2
Practical exercises (Lab. Work)		2
Drawing	2 elective	2 + 2 elect.
Total	22½ + 10 elective	28-½ + 4 elective

This table shows 7½ hours of science work out of a possible 32½ for the pupils in the philosophy section and 9 out of a possible 32½ for those in the mathematics section. During the three

years of the second cycle the pupils of the mathematics section or of the science-language section may take 17-½ hours in science out of 86-½ hours or about 20%.

During the two cycles a pupil in the science sections may take 21 hours of physics and chemistry, 7 hours of natural sciences and a course of 12 lectures in geology. During the same time the non-scientific student may take 7 hours of physics and chemistry, 5 of natural sciences and the course of 12 lectures in geology.

The Lycées which give the scientific courses are generally well supplied with demonstration apparatus and laboratories. Lycée Saint Louis, the great scientific Lycée in Paris, is unusually well provided in every respect. The laboratories are of the most modern type. Much of the apparatus is made by the school mechanician after the designs of the professors.

The pupil begins the study of natural sciences in the sixth class at about 11 years of age and takes up physical sciences two years later in the eighth class. With repeated reviews all of these studies are continued each year giving him a well rounded and lasting knowledge of general science by the time he obtains his baccalaureate, at the end of the course.

The following is a much abbreviated syllabus of the work done in the science sections of the Lycées:

FIRST CYCLE.

VI. Class. 1 hour per week.

Zoölogy: Essential external characteristics of five classes of vertebrates; life history of important articulates; mollusks, worms; starfish, coral, and sponges.

V. Class. 2 hours per week.

Botany Study of external differences of plant organs; a few families of locally important phanerogames and cryptogams; dangerous mushrooms.

IV. Class. 2 hours per week.

Geology: Agents which change earth's surface; the great geological eras.

Physics: Gravitation, specific gravity, statics of liquids and gases, Boyle's law, thermometry, heats of fusion and evaporation.

Chemistry: Composition of water and air, sulphur, chlorine and their acids, ammonia, combustion, carbon, elements and compounds, formulae.

III. Class.

Zoölogy: 1 hour per week. Digestion, circulation, respiration,

contagious diseases, body temperature, nervous system, skeleton, muscles required for movement.

Physics: 1 hour per week. Nature and quality of sound, plane mirror, lenses (experimental), complexity of light, photography, magnetism, electrolysis, coulomb, ampere, electromagnet, Ohm's law, Joule's law, induction Gramme motor and dynamo.

Chemistry: 1 hour per week. Properties of metals and alloys, sodium and calcium compounds, silicates, mineral waters; Organic: acetylene, benzene, alcoholic and acetic fermentation, fats and fatty acids, glycerine, soaps, glucose, saccharine.

SECOND CYCLE.

II. Class: 3 hours + 2 hours laboratory work.

Geology: Review, geological eras cont—., prehistoric animals, volcanic action.

Physics: Review and extension of work of 4th class; composition of forces, machines, conservation of energy, specific heat, linear expansion, law of Charles and Gay-Lussac, fusion, vaporization, critical temperatures, vapor in the atmosphere.

Chemistry: Review and extension of work in 4th class; electrolysis of sodium chloride, law of definite proportions, nitrogen and compounds, laws of volumes, phosphorus and compounds, silicon.

I. Class: 3 hours + 2 hours laboratory.

Physics: Review and extension of 3rd class; velocity of light (Fizeau's method), spherical mirrors, total reflection, formulae for lenses and prisms, telescope, microscope; static electricity, potential difference, condensors, laws of Faraday, accumulators, magnetic flux, laws of induction, telegraph, telephone, Gramme motors and dynamos, furnaces, electrolysis.

Chemistry: Review and extension of work of 3rd class; aluminium and compounds, porcelain, alloys of copper, mercury, silver and compounds; organic compounds, carbohydrates, alcoholic and acetic fermentation, distillation of wood, amidon, cellulose.

Class of Mathematics: 5 hours physical and 2 hours natural sciences + 2 hours laboratory.

Physics: Falling bodies, effect of air resistance, laws of pendulum, second law of motion, mechanical equivalent of heat, steam and gas engines, indicator diagrams, principles of Carnot, laws of solutions; vibratory motion, interference, reflection, periodic phenomena in sound and light, spectroscopy, radiations; fundamentals of music; alternating currents, inductance, capacity, single

and polyphase machines, transformers, X-rays, wireless.

Chemistry: Principles of gravimetric and volumetric analysis, laws of combination by weight and volume, multiple proportions, molecular and atomic weights, laws of Avagadro, Mitscherlich, Dulong and Petit, determination of molecular weights, and atomic weights, valence, laws of Berthollet, metaloids; Organic: principles of organic analysis and synthesis, development of formulae carbohydrates, ethyl and methyl alcohol, ether, ethyl aldehyde, acetone, methylamine, acetic acid, ether salts, acetamide, cyanogen, glycerine, oxalic, lactic, and picric acids, analine.

Anatomy and physiology: Special function of human organs; principal types of organization in animal kingdom; special study of the functions of the organs of Phanerogams; principal types of organization in plant kingdom; general idea of evolution in plants and animals.

GOVERNMENT ADVOCATES USE OF LODGEPOLE PINE.

Lodgepole pine, of which there are abundant stands in both the Rocky Mountain and Coast ranges, when treated with preservatives ought to serve in the place of red cedar as a pole timber, says the department of agriculture in a bulletin just issued on Rocky Mountain woods for telephone poles.

The rapid extension of telephone and power lines in the west is making the question of pole supply one of increasing importance. Western red cedar, for long the standard pole timber of the western states, grows only in Washington, Oregon, and northern Idaho, and in the states south of that region its cost is high, owing to the great distance over which it must be transported. In addition, the heavy drain on the supply promises to result in increasingly higher prices.

The tendency to lodgepole pine to decay rapidly when in contact with the ground has so far kept it out of the field as a competitor of the cedar, according to the department, but the general adoption of preservative treatment by railroad and telephone companies changes the situation. At an additional cost for treatment that still leaves the pine pole the cheaper of the two in most markets outside the cedar region, states the department, the pine may be made to last longer than untreated cedar. Tests carried on at the forest service laboratory also showed lodgepole pine to be as strong as the cedar, if not actually stronger.

Fire-killed lodgepole pine, of which there is a vast quantity in the Rocky Mountain region, showed a strength under test 80 per cent that of live red cedar. In elastic values, the two were practically equal, and in stiffness, fire-killed lodgepole pine is quite comparable to the cedar. The prejudice against the use of fire-killed material is a mistaken one, says the department, for there is no inherent difference in wood seasoned on the stump and wood cut when green and then seasoned. On many areas such material remains entirely sound for a number of years after the fire which killed it and besides is thoroughly seasoned and thus ready for preservative treatment as soon as cut.

PHYSICS IN THE GRADES BELOW THE HIGH SCHOOL.[1]

By Earl R. Glenn,
Froebel School, Gary, Indiana.

Part II.

Introduction.

We make no attempt to define the *exact* aim in placing physics in the grades below the high school. It is evidently *not* to make physicists upon short notice, although it is well to keep in mind the fact that the interests aroused at this age are often very powerful factors in the life of an individual. It is true, although probably not well known, that Lord Kelvin was learning about the precession of a spinning body from his top before the age of ten and at the age of sixteen he wrote the first of his six hundred and eighty-six contributions to science, a volume of eighty-five pages, on *The Figure of the Earth*. In this, the youth deduced the ellipticity from the constant of precession, combined with Laplace's hypothetical law of density in the interior of the earth. Imagine an American youth reading the works of Poisson, Pratt, and Laplace at the age of sixteen! We all marvel at the wonderful genius of Lord Kelvin but it is interesting to remember that his father was teaching him mathematics, science, and language at an age when most American children are learning to add and subtract.

It is also known that an accidental discovery of Gregory's *Lectures on Experimental Philosophy* created a profound interest in science in Joseph Henry. And so one might name many similar examples in the history of physics. Yet, we face the condition that practically all children of the country must live their entire lives with practically no correct knowledge concerning the immediate physical world in which they must live. Less than 10 per cent of the pupils enrolled in the Indiana high schools study physics.[2] It is generally understood that only a small fraction of the total school enrollment ever reaches the last years of the secondary schools.

The specific purpose of this study is to get *some* basis for judging the efficiency of the teaching of physics in the grades below the high school, as discussed elsewhere[3] and to determine if possible the amount and kind of work that is best suited to

[1]Copyright, 1914, by Earl R. Glenn. An abstract of a paper read before the Physics and Chemistry Section of the Indiana Association of Science and Mathematics Teachers, held in Indianapolis, March 7, 1914.

[2]Glenn, Earl R. *High School Physics in the State of Indiana.* School Science and Mathematics, Vol. 13, Pages 883-891.

pupils in the seventh grade. This is an attempt also to learn whether the laboratory method can be used successfully with the grammar grades and incidentally (since segregation follows in these schools, as a result of the program), to see if there is any specific difference in the quality of the work done by boys and girls.

Collection of Data.

The course was divided into thirteen experiments and one week was devoted to each exercise. The thirty minute tests, to be considered later, were given the fifth day, at the close of the experimental work and the corresponding discussions. The papers were usually graded and returned the next school day. All mistakes were indicated with red ink and the pupils were frequently required to rewrite the entire paper. The questions were taken from the course previously described[4] and were usually selected the night preceding the test. They were not selected with great deliberation and certainly can be improved. The examinations were given in two schools the same day. Each instructor graded his own pupils on the tests but it has been found by grading sets of unmarked papers that no appreciable difference existed in standards of grading. It was not decided to give identical tests in the two schools until the beginning of the fourth week of the term. Previous to this the writer made his own selection of questions. This explains the blanks in the table of data. In a few cases, the questions were selected hurriedly as one must often do under the actual and very real conditions of school activity. The facts concerning nationality, occupation of father, number of years in the schools under consideration, and the total number of years in school, were obtained from the pupils. These are shown simply to indicate something of the conditions under which this study has been made.

Sources of Error.[5]

Considerable interest now centers around the reliability of tests and grades given by teachers. If there is any problem demanding attention, it is this one, and since the major portion of this paper is concerned with tests, the writer begs to present two widely divergent views upon this question. In a recent issue of School Science and Mathematics, we find two very interesting papers and the following quotations are selected[6]:

---

[4] McClellan, John H. *Physics in the Grades Below the High School.* Part I. School Science and Mathematics, Vol. 14, Pages 504-515.

[5] The author expects to use a more comprehensive scheme of testing the results of teaching than this paper indicates. This data, together with that from sixty new pupils, will be studied by a different method.

[6] Anderson, Mrs. Jane Pollock. *The Traditional Examination,* School Science and Mathematics, Vol. 14, Pages 193-204.

TABLE I.

Data Concerning a Beginning Seventh Grade Class (Girls).

No.	Nationality.	Occupation of father.	No. of years in this School.	Total No. of yrs. in School.	Weekly grades, based on written tests, given at the end of the work on each experiment.												
					1	2	3	4	5	6	7	8	9	10	11	12	13
1	Dane	Carpenter	5	6	99	85	79	40	78	86	58			90	76	100	76
2	French	Hotel keeper	6	6	96	93	98	95	88	66	79	72	32	56	64	98	95
3		Conductor			98	58	79	60	89	80		87	92	80	99	99	79
4	Hebrew	Merchant	.5	7	99	70	100	80	98	100	85	57	80	59	78	100	97
5	German	Chef	4.5	8	60	95	95		100	60		55	80	79	98	80	59
6	Russian	Contractor	4	6	39	70	60	59		80	69	100	91	80	76	80	98
7	German	Carpenter	4	6	71	54	75	59	79	60	64	90	76	60	98	80	68
8	German	Carpenter	5	6	80		80	70	98	78	65	73	60	100	87	99	75
9	German	Carpenter	5	6	100		80	100	78	100	78	98	98	99	100	80	100
10	Irish	Lather	5.5	6	59	51	98	60	89	90	92	88	64	78			93
11	Slavish	Merchant	4	6	36	86	99	19	89	34	34	60	57	59		90	77
12	American	Lather	4		77	63	96	57				62		58		55	48
13	English	Laborer	3.5	10	39	70	78	39	79	33	55	51			69	20	78
14	English	Machinist	.5	7	79	75	59	60	80	80	52	80	100	77	98	100	60
15	American	Carpenter	2.5	5	99	81	79	98	79	89		85	90	89	75	80	79
16	Hungarian	Laborer	4	6	79	95	100	60	80	45	77	75	70	79	71	100	74
17	Austrian	Laborer	4.5	6	79	75	100	80	64	89		84	38	100	79	100	80
18	American	Laborer	2	5	76	99	98	60	89	88	95	68	92	80	96	96	80
19	Hebrew	Clothier	3.5	5	100	100	60	100	80	90	70	50	80	70	74	80	100
20	Croatian	Contractor	.5	6.5	53	64	20	19	67	69	45	65	20	60	54	89	77
21	Croatian	Contractor	.5	6.5	80	70	59	30	89	79	37	65	77		90	80	79
22	American	Engineer	6	6				75	98	94	95	93	68	83	91	96	75
23	American	Undertaker	1	6					98	100	90	100	94	97	91	58	88
24	Hebrew	Contractor	5	6				100	98	97	43	96	75	71	97	70	56
25	American	Bowling Alley	4	4				76	69	90	86	88				71	42
26	American	Carpenter	3	5				100	92	100	94			93	84	46	55
27	American	Storekeeper	3	5				79	91		80	58	81	90	94	72	94
28	Bohemian	American Bridge Co.	2	6				94	91	80	60	55	53	73	65	49	73
29	German	Fisherman	5	7				96	97	99	95	94	85	93	99	31	
30	American	.....	5	7				80	90	100	86	91	79	89	92	59	
31	American	Machinist	4	6				16	83	58		66		70	47	30	60
32	English	Inland Steel Company	1	5				90	95	97		98	60		84	75	49
33	American	Real Estate	4	7				99	88	75		89	83	79	79	70	73
34	American	Minister	2	6				99	88	97		88	78	67	85	95	80
35	American	Sheet & Tin Plate	3	6				100	99	95	80	95	89	88	90	42	65
		Averages			76.1	76.5	80.5	71.1	86.9	81.1	71.6	78	73.8	72.9	83.2	75.5	75.2

TABLE II.

Data Concerning a Beginning Seventh Grade Class (Boys).

No.	Nationality.	Occupation of father.	No. of years in this School.	Total No. of yrs. in School.	Weekly grades, based on written tests, given at the end of the work on each experiment.												
					1	2	3	4	5	6	7	8	9	10	11	12	13
1	Croatian	Laborer	4	6	99	100	100	96		99	99	100	95	79	98	80	100
2	Croatian	Saloonkeeper	2.5	7	34	93	78	80	75	95	65	95	63	59	55	77	65
3	Croatian	Carpenter	6	7	94	98	100	60	88	94	64	85	68	100	73	67	38
4	Dane	Saloonkeeper	7	10	98	93	77	80	87	86	40	74	73	85	97	80	78
5	American	Contractor	6	6	99		97	99	93			95	90	90			92
6	Hebrew	Groceryman	6	7	57	65	99	79	84	97	73	64	76	49	55	99	
7	Negro	Electrician	5	7	38	87	99	100	76	70	74	82	88	88	97	79	96
8	German	Laborer	2.5	8	40	80	80	100	96	100	80	80	79	89	79	80	100
9	Slavish	Carpenter	6.5	8	58	99		47	94	89	72	69	63	77	78	97	
10	American	Expressman	5	6	96	59				85	53	58	66		85	98	73
11	Hungarian	Carpenter	5		60	95			89	100	89	94	95	97	97	80	99
12	Lithuanian	Contractor	4.5	6.5	78	86	100	78	94	89	78	94	78	73	98	80	79
13	American	Real Estate	3	7				98	88	100	84	86	69	44	88	34	70
14	American	Foreman	3	6				94	89	100	97	79	81	91	75	72	88
15	Scotch	Engineer	4	8				33	67	36							
16	American	Grain dealer	4	5							59	62	30	86	89		47
17	Scotch	Machinist	2.5	6				91	72		79	75	70	86	40	73	
18	American	Carpenter	3	4					64	87	95	46	83	72	94		
19	Scotch	Foreman	2	8				77	61	72	77	79	75	47	88	88	73
20	American	Metal worker	3	7				91	91	87	58	66	72	60	90	77	76
21	American	Insurance	6	7				35	63	93	64	91	77	32	87	75	49
22	Irish	Laborer	3	7				75	66	95	77	42	51		91	65	42
23	American	Engineer	3	5				99	97	78	95	85	92	96			
24	German	Foreman	2	5				99	90	95	98	98	94	95	93	87	100
25	American	Laborer	2	4				93	87	83	80	78	89	77	99	98	98
26	Hungarian	Tailor	1	9				88	87	68	76	88	67	87	100	78	84
27	French	.....	5	5				91	69			89	72	57	96	94	85
28	American	Foreman	2	7				50	87	70	85	89	99	67	93	97	55
29	Bohemian	Wholesale dealer	3	5				59	87	80		90	86	89	92	70	64
30	Bohemian	Hardware dealer	3.5	5				74	83	93	88	88	52	82	94	76	83
31	American	Physician	1	6				77	90	93	72	99	99	79	73	51	87
32	American	Physician	4	6				27	35	87	82	96	84	75	97	86	
33	German	Salesman	5	8				67	90	94	98	98	89	87	89	64	66
		Averages			90.9	86.8	92.2	77.1	83.9	86.7	77.3	81.6	77	76.5	86	78.6	76.4

"I am absolutely opposed to the traditional examination, and would like to see it die out with other useless antiquities..... .....When we listen to statistics in regard to teachers varying from 95% to 25% on the same paper, when corrected by hundreds of teachers, the same statistics in regard to college professors, school principals, and superintendents, when we hear of the customs of certain teachers always to give 80% to 95%, some to give many A's, others never to give any A's, we realize that most teachers in correcting papers 'can make figures lie.'"

A few pages over in the same journal we find these statements[7]:

"Reduce oral work to the least possible amount, increase the written work up to the limit of the teacher's strength and health. ..... In order to find time for written work the time of lecture table demonstration work can be reduced until no class room experiments are performed except those necessary to make certain laws clear..... By written work is meant 'written under the eye of the teacher in absolute silence like an examination.'"

Between these two extreme means we must effect some compromise, because we recall that physicians, ministers, teachers, dentists, druggists, veterinary surgeons, master mechanics, engineers, and all civil service applicants must pass examinations before entering upon their life work. Written examinations are now required in some trades.

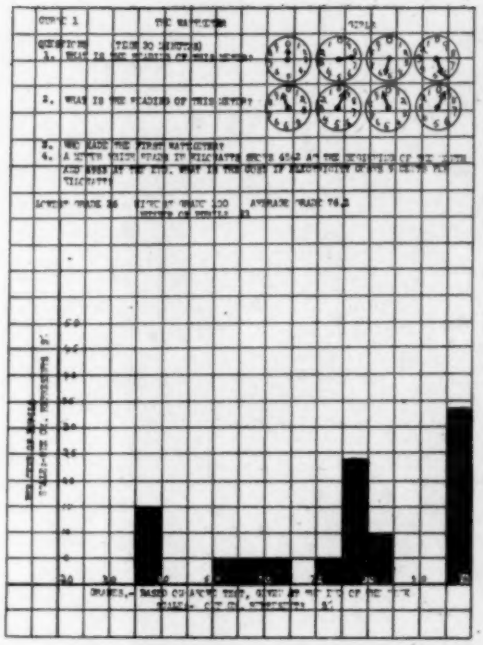
From another journal we quote the following[8]:

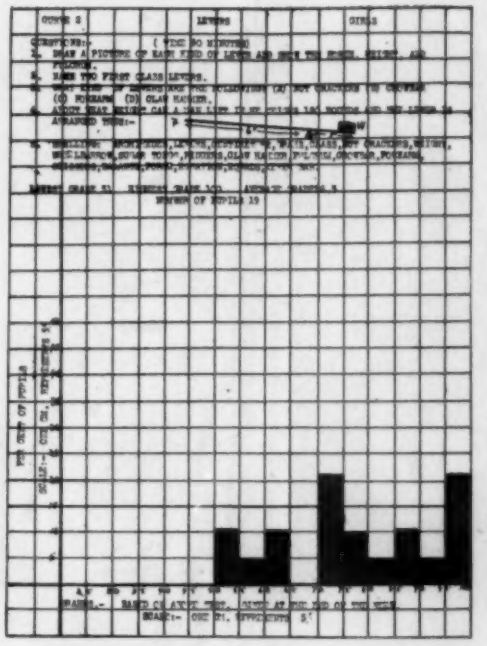
"There seems to me to be little justification for the attitude of those who claim that our scales or units of measurement are not yet sufficiently refined. A higher degree of accuracy in the application of units or scales of measurement, and better scales, will be derived only when those who are interested in the results of instruction are willing to try out the tools already available. I do not believe that it is possible for anyone to attempt to use these scales without discovering very great variability within any group of schools or classes which are supposedly being taught the same subject by equally competent teachers. ..... The tendency must be increasingly to measure the efficiency, or inefficiency, of our schools in terms of the results achieved by

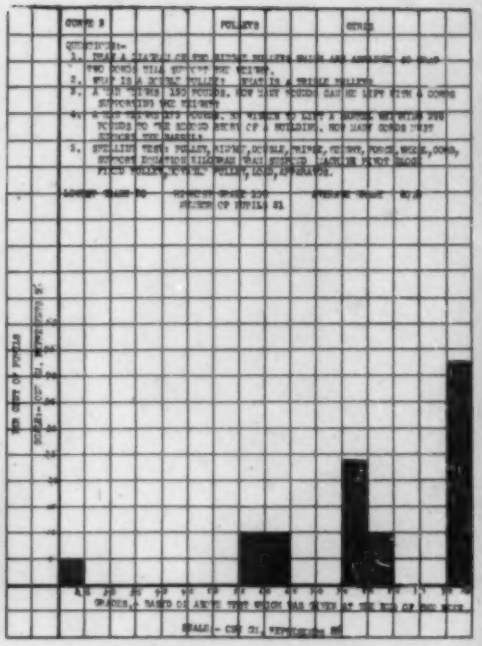
---

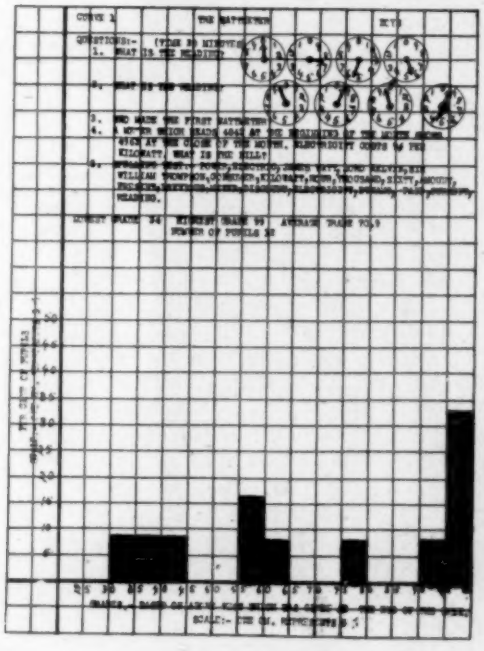
[7]Sidney, Almer-Small. *Failures in Physics at the College Entrance Examination Board—The Cause and the Remedies.* SCHOOL SCIENCE AND MATHEMATICS, Vol. 14, Pages 205-210.

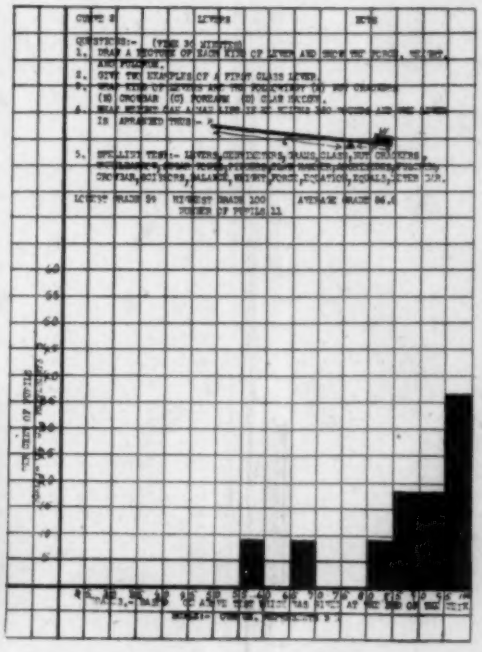
[8]Strayer, George Drayton. *Is Scientific Accuracy Possible in the Measurement of Efficiency of Instruction* in *Education*, December, 1913, Pages 247-258.

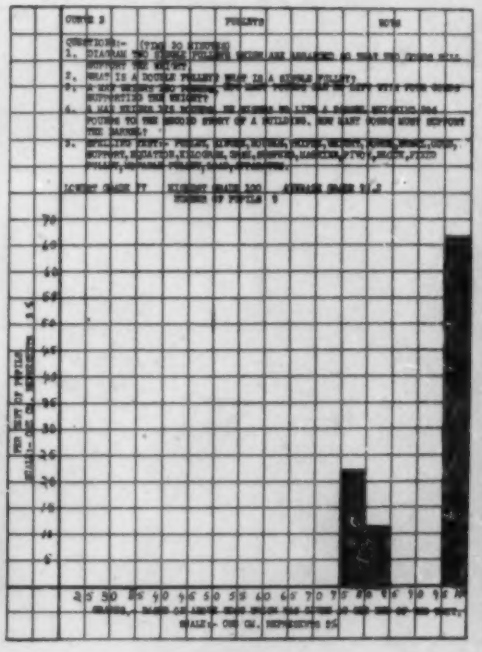


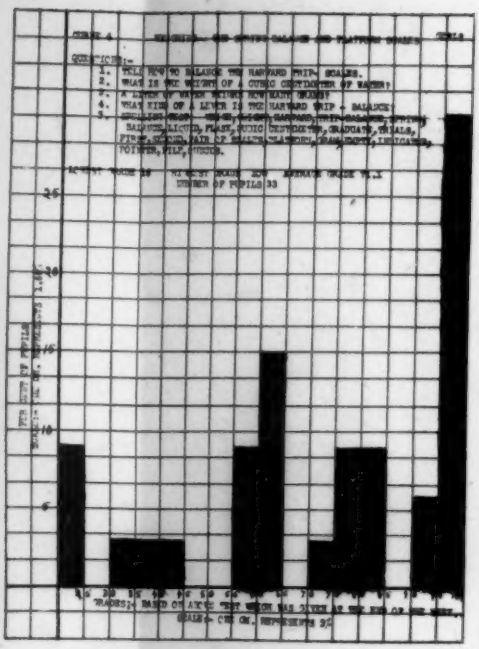


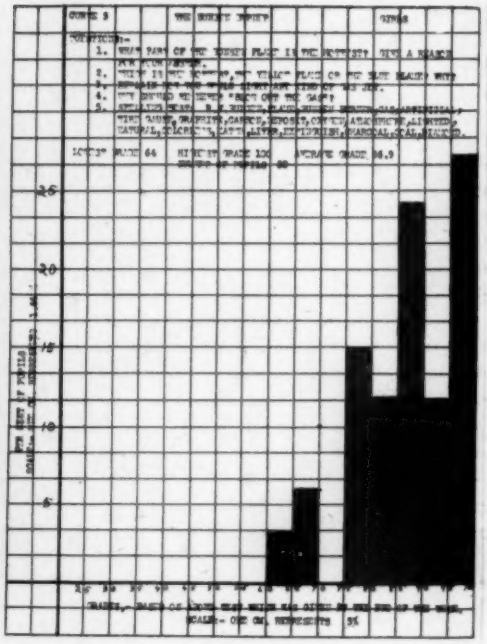


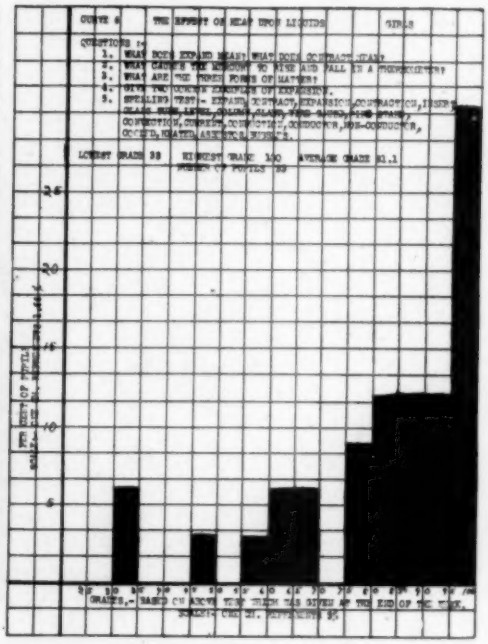


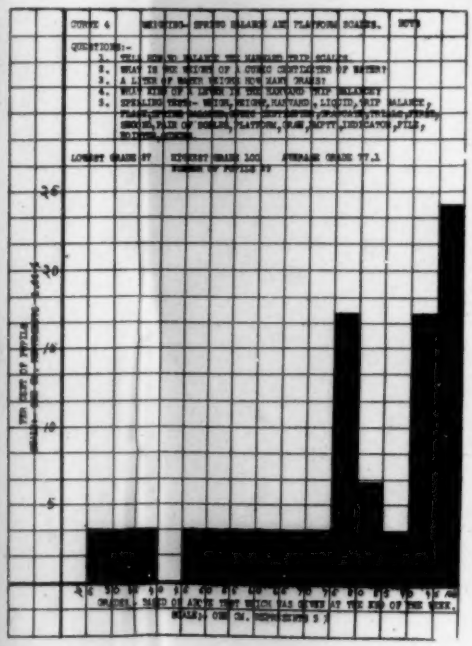


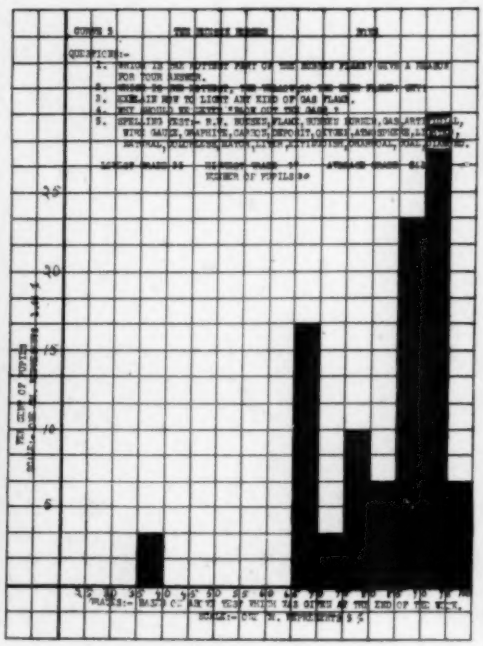


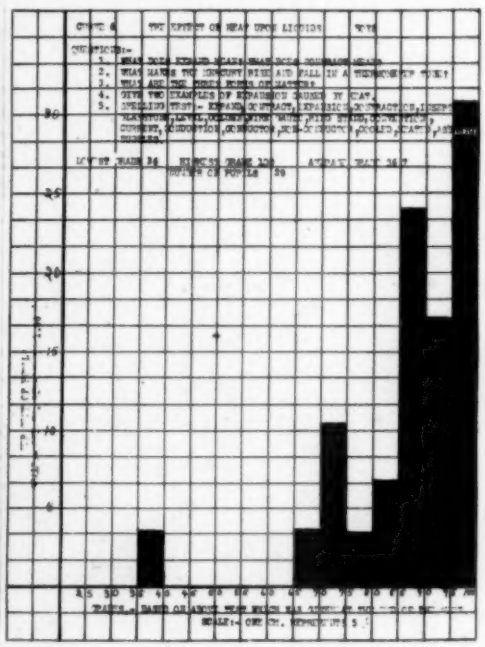

QUESTIONS:-
1. TELL HOW TO BALANCE THE HARVARD TRIP- BALANCE.
2. WHAT IS THE WEIGHT OF 1 CUBIC CENTIMETER OF WATER?
3. A LITER OF WATER WEIGHS HOW MANY GRAMS?
4. WHAT KIND OF A LEVER IS THE HARVARD TRIP - BALANCE?
5. SPELLING TEST- WEIGH, WEIGHT, HARVARD, LIQUID, TRIP BALANCE, BALANCE, LIQUID, FLASK, SCALE, GRADUATE, TRIALS, FULCRUM, SCALES, PAIR OF BALANCE, CAPACITY, GRAM, ENOUGH, INDICATOR, POINTER, PIN, SCALES.
LOWEST GRADE 39 HIGHEST GRADE 100 AVERAGE GRADE 78.1
NUMBER OF PUPILS 33
PER CENT OF PUPILS
GRADES:- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5%

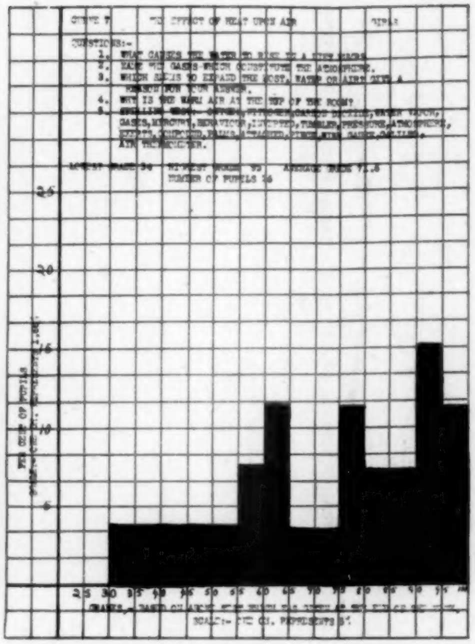

QUESTIONS:-
1. WHAT PART OF THE EARTH'S CRUST IS THE ANTHRACITE? GIVE A REASON
2. WHY IS THERE SO MUCH "ANTHRACITE" IN THE VICINITY OF PHILADELPHIA?
3. EXPLAIN HOW THE COAL BECAME FORMED AT THE END OF THE WEEK.
4. WHY SHOULD WE NEVER "SHUT OFF THE GAS"?
5. SPELLING TEST- B.T. BURNER, FLAME, BUNSEN BURNER, GAS, ARTIFICIAL, WING BAFFLE, GRAPHITE, CARBON, DEPOSIT, OXYGEN, ATMOSPHERE, LIGHTED, NATURAL, QUARTER-HEATER, LIVER, OXYDATION, CHEMICAL, HOLLOW.
LOWEST GRADE 64 HIGHEST GRADE 100 AVERAGE GRADE 86.9
NUMBER OF PUPILS 20
PER CENT OF PUPILS
GRADES:- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5%

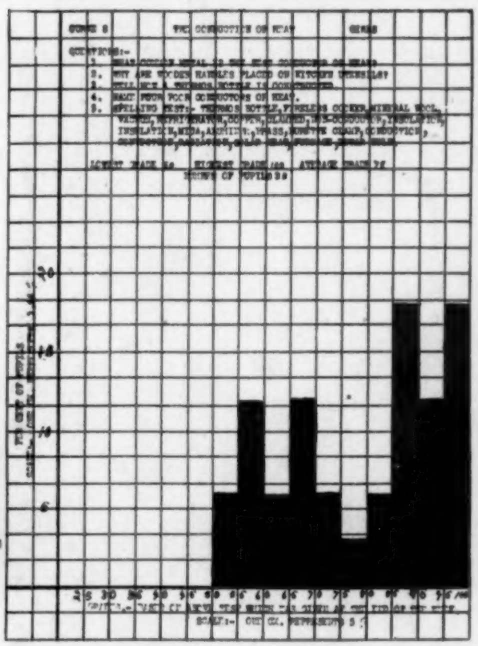

QUESTIONS:-
1. WHAT DOES EXPAND MEAN? WHAT DOES CONTRACT MEAN?
2. WHAT CAUSES THE MERCURY TO RISE AND FALL IN A THERMOMETER TUBE?
3. WHAT ARE THE THREE FORMS OF MATTER?
4. GIVE TWO EXAMPLES OF EXPANSION.
5. SPELLING TEST- EXPAND, CONTRACT, EXPANSION, CONTRACTION, INSECT, GLASS, ROOM, LEVEL, COLORS, GLASS, TUBE, WATER, THE BULB, CONVERSION, CURRENT, CONDUCTOR, NON-CONDUCTOR, NON-CONDUCTOR, CONDUCTOR, WATER, ANSWER, NUMBER.
LOWEST GRADE 88 HIGHEST GRADE 100 AVERAGE GRADE 91.1
NUMBER OF PUPILS 20
PER CENT OF PUPILS
GRADES,- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5%

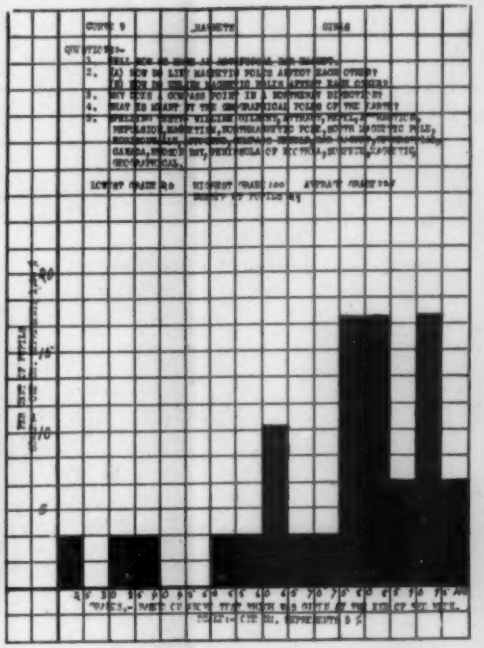

QUESTIONS:-
1. TELL HOW TO BALANCE THE HARVARD TRIP SCALES.
2. WHAT IS THE WEIGHT OF 1 CUBIC CENTIMETER OF WATER?
3. A LITER OF WATER WEIGHS HOW MANY GRAMS?
4. WHAT KIND OF A LEVER IS THE HARVARD TRIP BALANCE?
5. SPELLING TEST- WEIGH, WEIGHT, HARVARD, LIQUID, TRIP BALANCE, FLASK, SCALES, GRADUATE, TRIALS, FULCRUM, SCALES, PAIR OF BALANCE, ENOUGH, PIN OF BOARD, PLATFORM, PIN, BAFFLE, INDICATOR, FILE, POINTER, STRONG.
LOWEST GRADE 87 HIGHEST GRADE 100 AVERAGE GRADE 97.3
NUMBER OF PUPILS 33
PER CENT OF PUPILS
GRADES:- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5 %

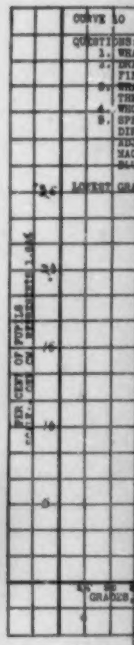

QUESTIONS:-
1. WHICH IS THE BRIGHTEST PART OF THE BUNSEN FLAME? GIVE A REASON FOR YOUR ANSWER.
2. WHICH IS THE HOTTEST, THE YELLOW OR THE BLUE FLAME? WHY?
3. EXPLAIN HOW TO LIGHT ANY KIND OF GAS FLAME.
4. WHY SHOULD WE NEVER SMOKE AND THE GAS?
5. SPELLING TEST- B.T. BURNER, FLAME, BUNSEN BURNER, GAS, ARTIFICIAL, WING BAFFLE, GRAPHITE, CARBON, DEPOSIT, OXYGEN, ATMOSPHERE, LIGHTED, NATURAL, QUARTER-HEATER, LIVER, OXYDATION, CHEMICAL, HOLLOW.
LOWEST GRADE 84 HIGHEST GRADE 97 AVERAGE GRADE 91.8
NUMBER OF PUPILS 20
PER CENT OF PUPILS
GRADES:- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5 %

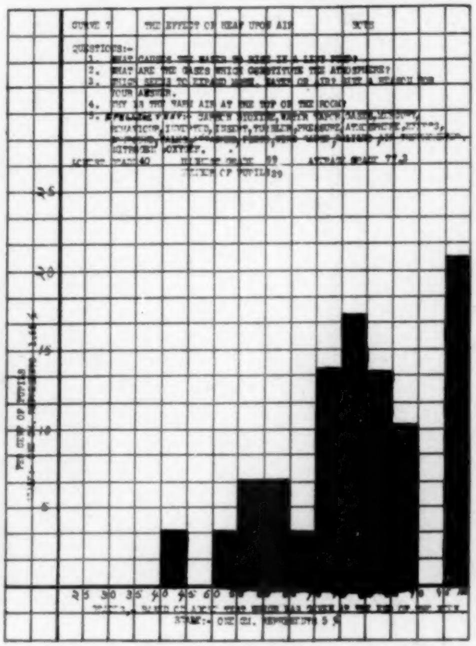

QUESTIONS:-
1. WHAT DOES EXPAND MEAN? WHAT DOES CONTRACT MEAN?
2. WHAT MAKES THE MERCURY RISE AND FALL IN A THERMOMETER TUBE?
3. WHAT ARE THE THREE FORMS OF MATTER?
4. GIVE TWO EXAMPLES OF EXPANSION.
5. SPELLING TEST- EXPAND, CONTRACT, EXPANSION, CONTRACTION, INSECT, GLASS, ROOM, LEVEL, COLORS, GLASS, TUBE, WATER, THE BULB, CONVERSION, CURRENT, CONDUCTOR, NON-CONDUCTOR, NON-CONDUCTOR, CONDUCTOR, WATER, ANSWER, NUMBER.
LOWEST GRADE 84 HIGHEST GRADE 100 AVERAGE GRADE 92.7
NUMBER OF PUPILS 20
PER CENT OF PUPILS
GRADES,- BASED ON ARITH TEST WHICH HAS GIVEN AT THE END OF THE WEEK.
SCALE:- ONE CM. REPRESENTS 5 %

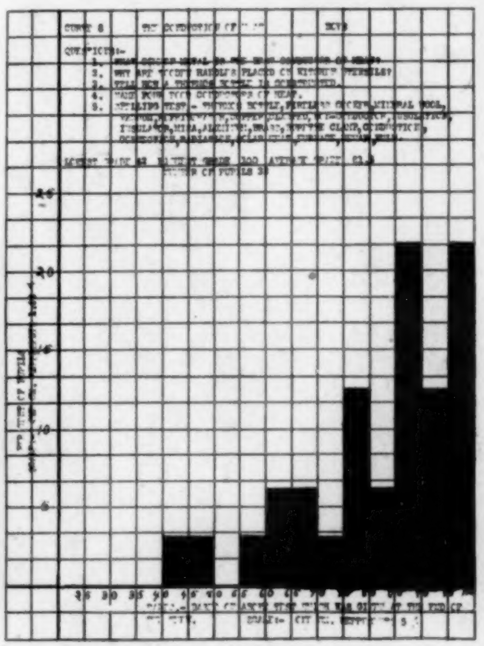

THE EFFECT OF HEAT UPON AIR
QUESTIONS:-
WHY IS THE WARM AIR AT THE TOP OF THE ROOM?

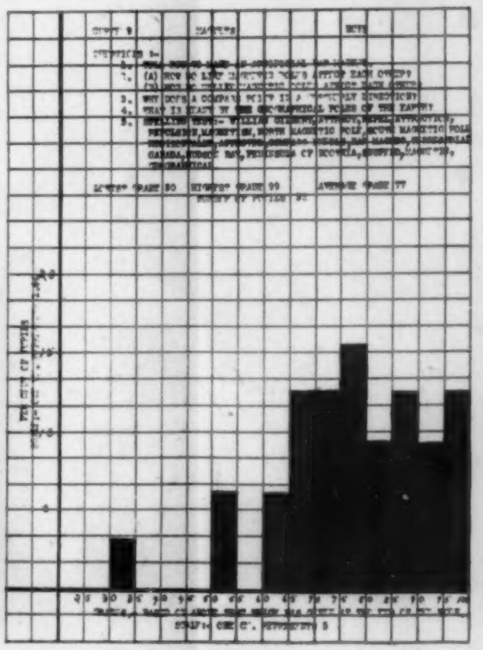

CURVE 8
QUESTIONS:-
WHY ARE WOODEN HANDLES PLACED ON KITCHEN UTENSILS?

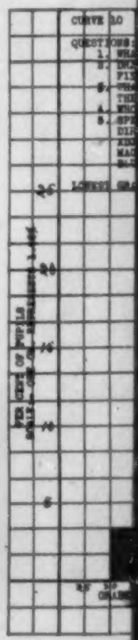

CURVE 9
MAGNETS
GIRLS
QUESTIONS:-

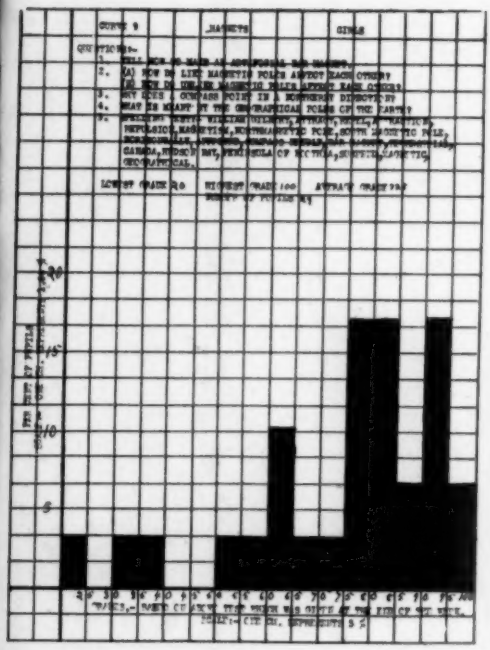

CURVE 10
QUESTIONS:
LOWEST GRA

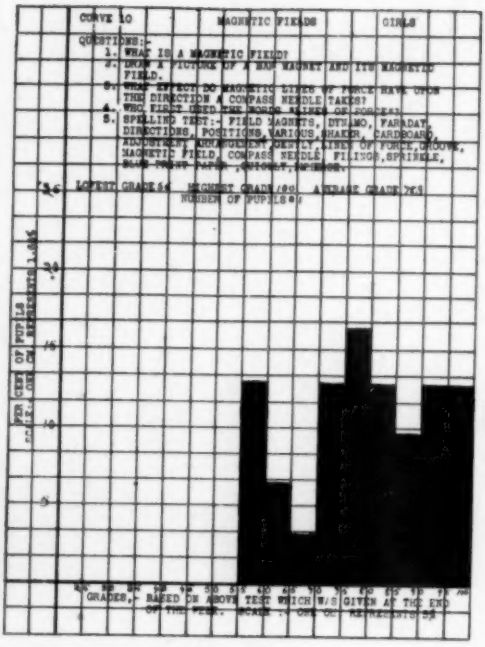

CURVE 7
THE EFFECT OF HEAT UPON AIR
BOYS
QUESTIONS:-

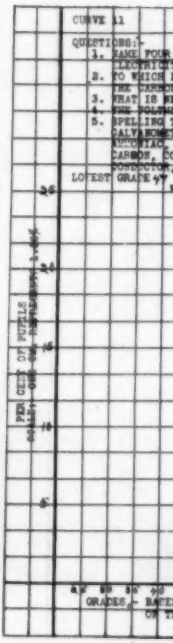

CURVE 8
BOYS
QUESTIONS:-

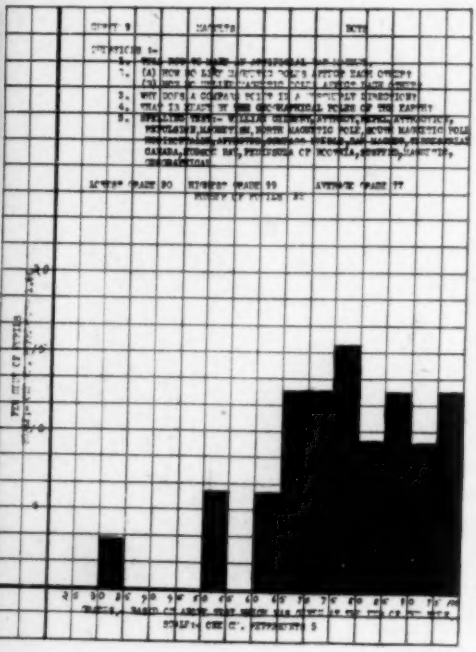

CURVE 9
BOYS
QUESTIONS:-

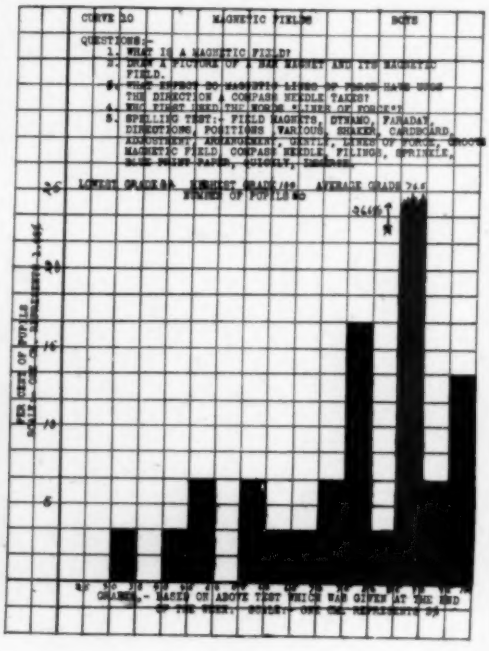

CURVE 10
QUESTIONS:

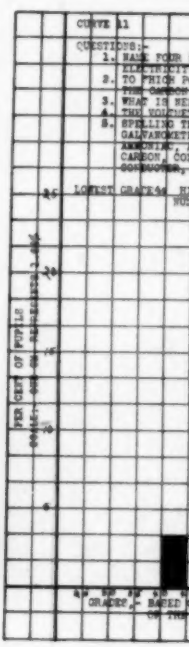

CURVE 9 MAGNETS GIRLS
QUESTIONS:-
1. WHAT IS A MAGNETIC FIELD?
2. (A) HOW DO LIKE MAGNETIC POLES AFFECT EACH OTHER?
(B) HOW DO UNLIKE MAGNETIC POLES AFFECT EACH OTHER?
3. WHY DOES A COMPASS POINT IN A NORTHERLY DIRECTION?
4. WHAT IS MEANT BY THE GEOGRAPHICAL POLES OF THE EARTH?
5. SPELLING TEST:- MAGNETIC, MAGNETISM, MAGNETIZE, MAGNETIC POLE, MAGNETIC MAGNETISM, NORTH MAGNETIC POLE, SOUTH MAGNETIC POLE, HORSESHOE, ARMATURE, COMPASS NEEDLE, FILINGS, SPRINKLE, GAUSS, MEDICINE BOX, PENINSULA OF NOVOTNIA, SERVICE, LAKE TIC, GEOGRAPHICAL.
LOWEST GRADE 80 HIGHEST GRADE 100 AVERAGE GRADE 93.7
NUMBER OF PUPILS 83
PER CENT OF PUPILS
GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE TERM. SCALE:- ONE CM. REPRESENTS 5


CURVE 10 MAGNETIC FIELDS GIRLS
QUESTIONS:-
1. WHAT IS A MAGNETIC FIELD?
2. DRAW A PICTURE OF A BAR MAGNET AND ITS MAGNETIC FIELD.
3. WHAT EFFECT DO MAGNETIC LINES OF FORCE HAVE UPON THE DIRECTION A COMPASS NEEDLE TAKES?
4. WHO FIRST USED THE WORDS 'LINES OF FORCE'?
5. SPELLING TEST:- FIELD MAGNETS, DYNAMO, FARADAY, DIRECTIONS, POSITIONS, VARIOUS, SHAKEN, CARDBOARD, ADJUSTMENT, ARRANGEMENT, GENTLY, LINES OF FORCE, GROUND, MAGNETIC FIELD, COMPASS NEEDLE, FILINGS, SPRINKLE, BLUE VELVET PAPER, QUICKLY, TWICE.
LOWEST GRADE 86 HIGHEST GRADE 100 AVERAGE GRADE 94.1
NUMBER OF PUPILS 83
PER CENT OF PUPILS
GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE TERM. SCALE:- ONE CM. REPRESENTS 5


CURVE 11
QUESTIONS:-
1. NAME FOUR
ELECTRICI
2. TO WHICH
THE CARBON
3. WHAT IS M
4. THE VOLTAI
5. SPELLING T
GALVANOME
AMMETER,
CARBON, CO
SOLUTION,
LOWEST GRADE 94
PER CENT OF PUPILS
GRADES.- BASED


CURVE 9 MAGNETS BOYS
QUESTIONS:-
2. (A) HOW DO LIKE MAGNETIC POLES AFFECT EACH OTHER?
(B) HOW DO UNLIKE MAGNETIC POLES AFFECT EACH OTHER?
3. WHY DOES A COMPASS POINT IN A NORTHERLY DIRECTION?
4. WHAT IS MEANT BY THE GEOGRAPHICAL POLES OF THE EARTH?
5. SPELLING TEST:- MAGNETIC, MAGNETISM, MAGNETIZE, MAGNETIC POLE, MAGNETISM, NORTH MAGNETIC POLE, SOUTH MAGNETIC POLE, HORSESHOE, ARMATURE, COMPASS NEEDLE, FILINGS, SPRINKLE, GAUSS, MEDICINE BOX, PENINSULA OF NOVOTNIA, SERVICE, LAKE TIC, GEOGRAPHICAL.
LOWEST GRADE 80 HIGHEST GRADE 99 AVERAGE GRADE 87
NUMBER OF PUPILS 85
PER CENT OF PUPILS
GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE TERM. SCALE:- ONE CM. REPRESENTS 5

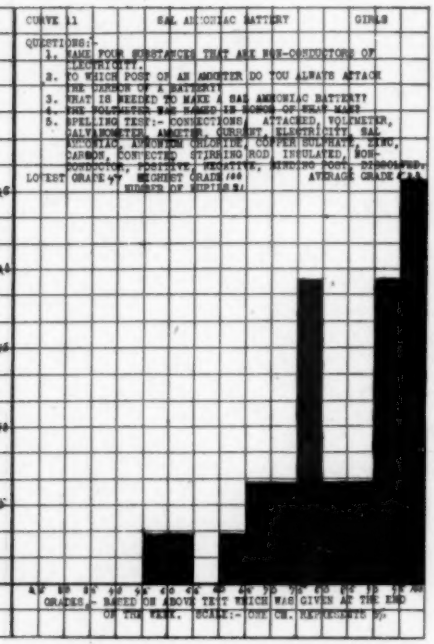

CURVE 10 MAGNETIC FIELDS BOYS
QUESTIONS:-
1. WHAT IS A MAGNETIC FIELD?
2. DRAW A PICTURE OF A BAR MAGNET AND ITS MAGNETIC FIELD.
3. WHAT EFFECT DO MAGNETIC LINES OF FORCE HAVE UPON THE DIRECTION A COMPASS NEEDLE TAKES?
4. WHO FIRST USED THE WORDS 'LINES OF FORCE'?
5. SPELLING TEST:- FIELD MAGNETS, DYNAMO, FARADAY, DIRECTIONS, POSITIONS, VARIOUS, SHAKEN, CARDBOARD, ADJUSTMENT, ARRANGEMENT, GENTLY, LINES OF FORCE, GROUND, MAGNETIC FIELD, COMPASS NEEDLE, FILINGS, SPRINKLE, BLUE VELVET PAPER, QUICKLY, TWICE.
LOWEST GRADE 84 HIGHEST GRADE 100 AVERAGE GRADE 94.6
NUMBER OF PUPILS 85
26%
PER CENT OF PUPILS
GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE TERM. SCALE:- ONE CM. REPRESENTS 5


CURVE 11
QUESTIONS:-
1. NAME FOUR
ELECTRICIT
2. TO WHICH P
THE CARBON
3. WHAT IS ME
4. THE VOLTAI
5. SPELLING T
GALVANOMET
AMMETER,
CARBON, CO
SOLUTION,
LOWEST GRADE 94
PER CENT OF PUPILS
GRADES.- BASED

CURVE 11 SAL AMMONIAC BATTERY GIRLS

QUESTIONS:-
1. NAME FOUR SUBSTANCES THAT ARE NON-CONDUCTORS OF ELECTRICITY.
2. TO WHICH POST OF AN AMMETER DO YOU ALWAYS ATTACH THE CARBON OF A BATTERY?
3. WHAT IS NEEDED TO MAKE A SAL AMMONIAC BATTERY?
4. THE VOLTMETER HAS NAMES IN HOURS OF WHAT NAME?
5. SPELLING TEST:- CONNECTIONS, ATTACHED, VOLTMETER, GALVANOMETER, AMMETER, CURRENT, ELECTRICITY, SAL AMMONIAC, AMMONIUM CHLORIDE, COPPER SULPHATE, ZINC, CARBON, CONNECTED, STIRRING ROD, INSULATED, NON-CONDUCTOR, POSITIVE, NEGATIVE, BINDING POST, DISSOLVED, SOLUTION, SOLVE, ACID, WATER.

LOWEST GRADE 47 HIGHEST GRADE 100 AVERAGE GRADE 68.5
NUMBER OF PUPILS 31

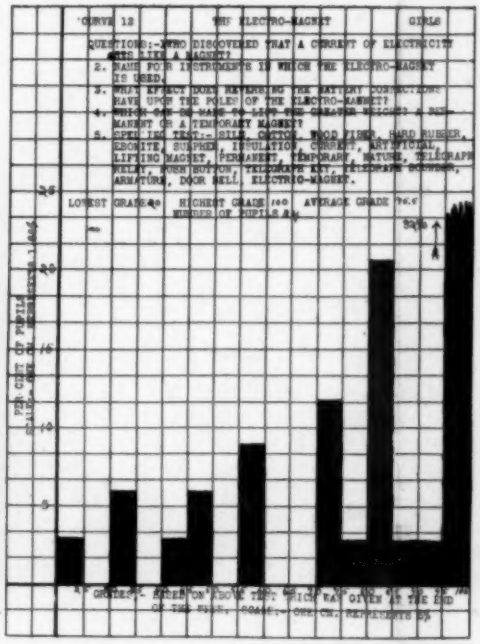


GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%

CURVE 12 THE ELECTRO-MAGNET GIRLS

QUESTIONS:-WHO DISCOVERED THAT A CURRENT OF ELECTRICITY ACTS LIKE A MAGNET?
2. NAME FOUR INSTRUMENTS IN WHICH THE ELECTRO-MAGNET IS USED.
3. WHAT EFFECT DOES REVERSING THE BATTERY CONNECTIONS HAVE UPON THE POLES OF THE ELECTRO-MAGNET?
4. WHICH CAN BE MADE TO LIFT THE GREATER WEIGHT, A PERMANENT OR A TEMPORARY MAGNET?
5. SPELLING TEST:- BELL, CURTAIN, WOOD FIBRE, HARD RUBBER, EBONITE, SULPHUR, INSULATOR, CURRENT, ARTIFICIAL, LIFTING MAGNET, PERMANENT, TEMPORARY, NATURE, TELEGRAPH RELAY, PUSH BUTTON, TELEGRAPH KEY, TELEGRAPH SOUNDER, ARMATURE, DOOR BELL, ELECTRO-MAGNET.

LOWEST GRADE 40 HIGHEST GRADE 100 AVERAGE GRADE 76.6
NUMBER OF PUPILS 24

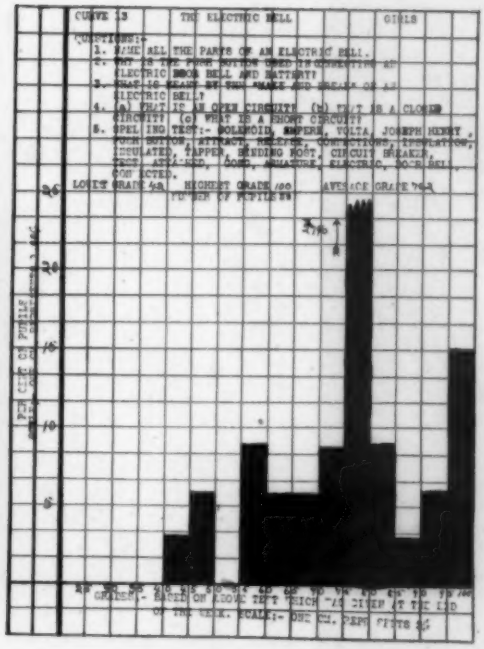


GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%

CURVE 13 THE ELECTRIC BELL GIRLS

QUESTIONS:-
1. NAME ALL THE PARTS OF AN ELECTRIC BELL.
2. WHY IS THE PUSH BUTTON USED IN CONNECTING AN ELECTRIC DOOR BELL AND BATTERY?
3. WHAT IS MEANT BY THE "MAKE AND BREAK" OF AN ELECTRIC BELL?
4. (a) WHAT IS AN OPEN CIRCUIT? (b) WHAT IS A CLOSED CIRCUIT? (c) WHAT IS A SHORT CIRCUIT?
5. SPELLING TEST:- BOLTHOLE, AMPERE, VOLTA, JOSEPH HENRY, PUSH BUTTON, ATTRACT, RELEASE, CONNECTIONS, INSULATION, INSULATED, TAPPER, BINDING POST, CIRCUIT BREAKER, CROSS ARMED, BOARD, ARMATURE, ELECTRIC, DOOR BELL, CONNECTED.

LOWEST GRADE 48 HIGHEST GRADE 100 AVERAGE GRADE 76.3
NUMBER OF PUPILS 29

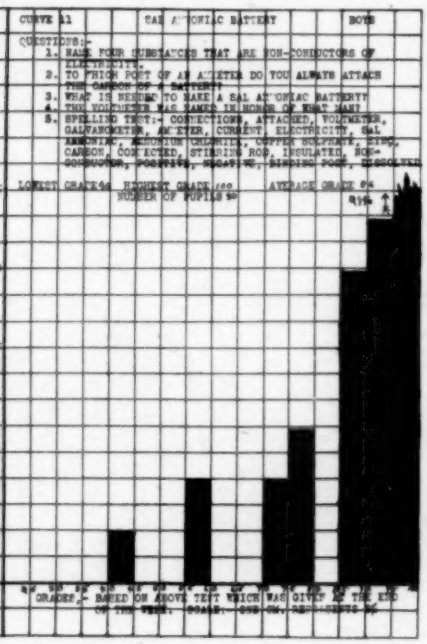


GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%

CURVE 11 SAL AMMONIAC BATTERY BOYS

QUESTIONS:-
1. NAME FOUR SUBSTANCES THAT ARE NON-CONDUCTORS OF ELECTRICITY.
2. TO WHICH POST OF AN AMMETER DO YOU ALWAYS ATTACH THE CARBON OF A BATTERY?
3. WHAT IS NEEDED TO MAKE A SAL AMMONIAC BATTERY?
4. THE VOLTMETER HAS NAMES IN HOURS OF WHAT NAME?
5. SPELLING TEST:- CONNECTIONS, ATTACHED, VOLTMETER, GALVANOMETER, AMMETER, CURRENT, ELECTRICITY, SAL AMMONIAC, AMMONIUM CHLORIDE, COPPER SULPHATE, ZINC, CARBON, CONNECTED, STIRRING ROD, INSULATED, NON-CONDUCTOR, POSITIVE, NEGATIVE, BINDING POST, DISSOLVED, SOLUTION, SOLVE, ACID, WATER.

LOWEST GRADE 56 HIGHEST GRADE 100 AVERAGE GRADE 84
NUMBER OF PUPILS 30

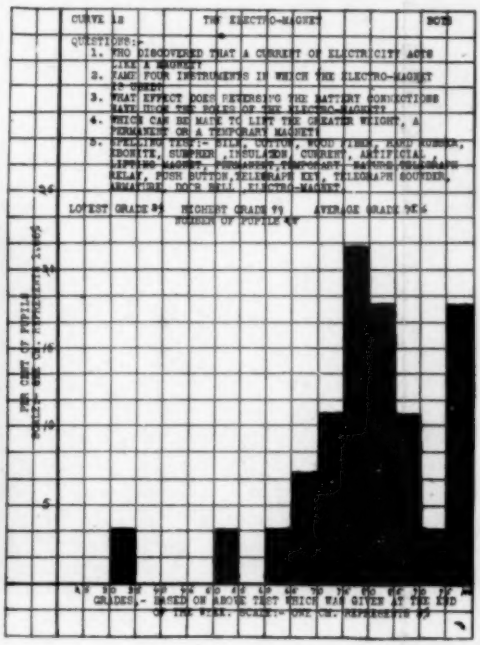


GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%

CURVE 12 THE ELECTRO-MAGNET BOYS

QUESTIONS:-
1. WHO DISCOVERED THAT A CURRENT OF ELECTRICITY ACTS LIKE A MAGNET?
2. NAME FOUR INSTRUMENTS IN WHICH THE ELECTRO-MAGNET IS USED.
3. WHAT EFFECT DOES REVERSING THE BATTERY CONNECTIONS HAVE UPON THE POLES OF THE ELECTRO-MAGNET?
4. WHICH CAN BE MADE TO LIFT THE GREATER WEIGHT, A PERMANENT OR A TEMPORARY MAGNET?
5. SPELLING TEST:- BELL, CURTAIN, WOOD FIBRE, HARD RUBBER, EBONITE, SULPHUR, INSULATOR, CURRENT, ARTIFICIAL, LIFTING MAGNET, PERMANENT, TEMPORARY, NATURE, TELEGRAPH RELAY, PUSH BUTTON, TELEGRAPH KEY, TELEGRAPH SOUNDER, ARMATURE, DOOR BELL, ELECTRO-MAGNET.

LOWEST GRADE 84 HIGHEST GRADE 93 AVERAGE GRADE 90.6
NUMBER OF PUPILS 27

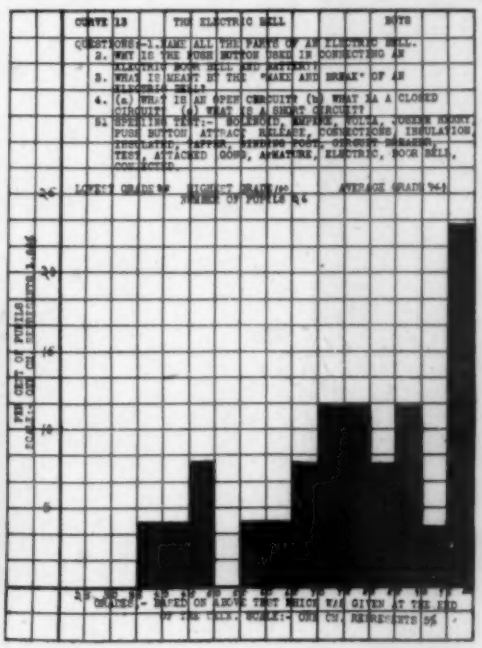


GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%

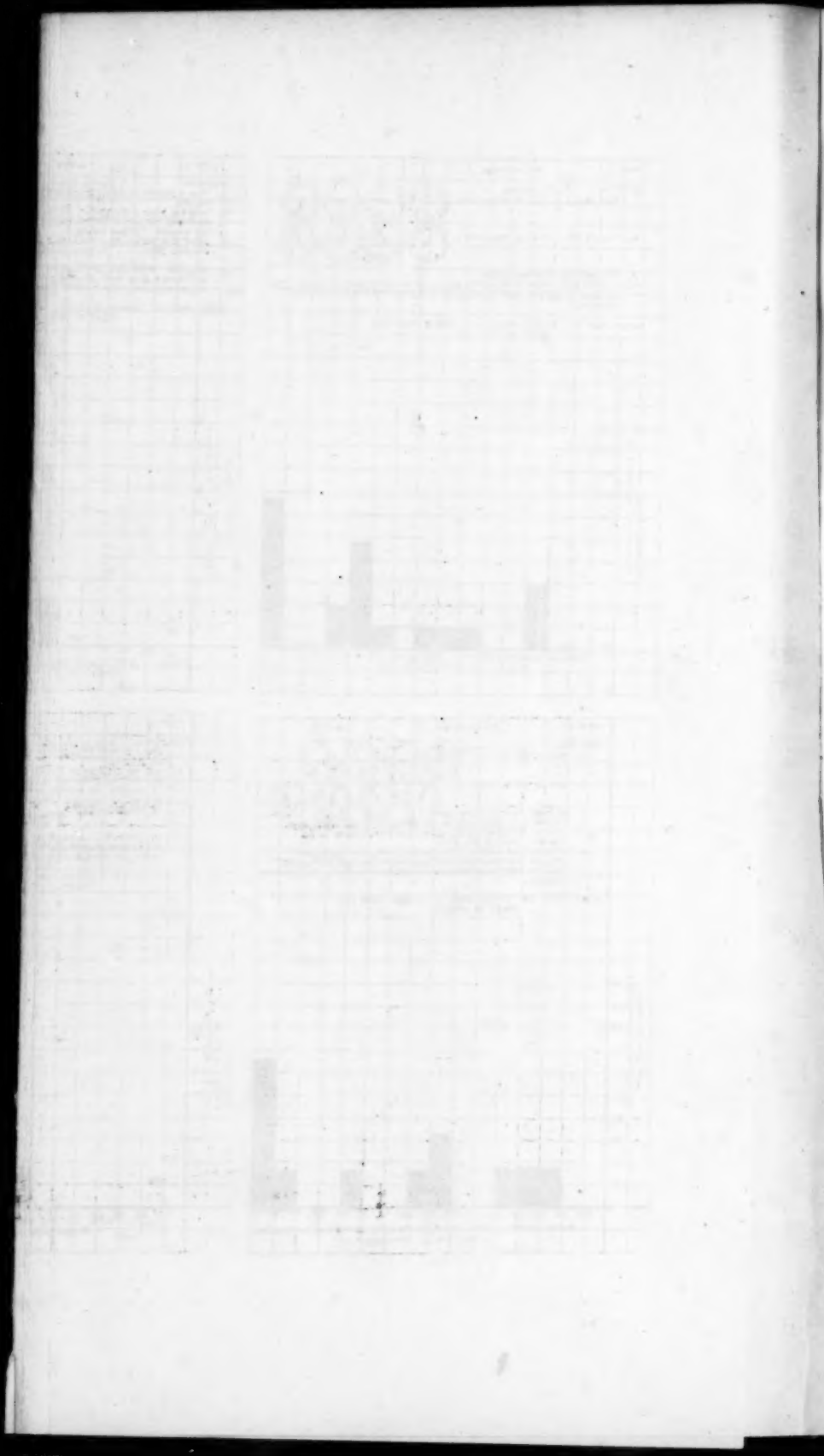
CURVE 13 THE ELECTRIC BELL BOYS

QUESTIONS:-1. NAME ALL THE PARTS OF AN ELECTRIC BELL.
2. WHY IS THE PUSH BUTTON USED IN CONNECTING AN ELECTRIC DOOR BELL AND BATTERY?
3. WHAT IS MEANT BY THE "MAKE AND BREAK" OF AN ELECTRIC BELL?
4. (a) WHAT IS AN OPEN CIRCUIT? (b) WHAT IS A CLOSED CIRCUIT? (c) WHAT IS A SHORT CIRCUIT?
5. SPELLING TEST:- BOLTHOLE, AMPERE, VOLTA, JOSEPH HENRY, PUSH BUTTON, ATTRACT, RELEASE, CONNECTIONS, INSULATION, INSULATED, TAPPER, BINDING POST, CIRCUIT BREAKER, TEST, ATTACHED, BOARD, ARMATURE, ELECTRIC, DOOR BELL, CONNECTED.

LOWEST GRADE 80 HIGHEST GRADE 100 AVERAGE GRADE 96.1
NUMBER OF PUPILS 24



GRADES.- BASED ON ABOVE TEST WHICH WAS GIVEN AT THE END OF THE WEEK. SCALE:- ONE CM. REPRESENTS 5%



pupils. In the field of business management, of administration, and supervision, as well as in instruction, we must continue to demand all of the avaliable facts reported unambiguously..... .....that we may hope to discover the principles of efficient action."

In addition to the errors, which the reader will recognize in a study of this kind, the following may be mentioned:

It is difficult to make a scientific analysis of one's own teaching.

There are differences due to two different schools, slightly different methods of instruction and standards of grading.

The absences of pupils cause the grades to be lower. All children present on the fifth day were required to take the test. It is not assumed that the percentage basis of grading is the correct form.

Analysis of Data.

The questions which were used for the tests and the corresponding distribution of grades for both boys and girls are shown on the following graphs. Two graphs have been made for each experiment in order to show, if possible, differences between the quality of work done by boys and girls. The curves for the class as a unit are reserved for future study in connection with another set of grades from sixty additional pupils. As will be noted, there are marked variations from the general form of probability curve[9]. In practically every case, the distribution is skewed toward the higher grades. These factors are to be taken into consideration in revising the course. A summary of the grades is shown in Table III.

Summary.

The descriptive aspects of physics can be very effectively taught in the grades below the high school. The exact grade can hardly be determined but it should be the sixth or seventh grade. Pupils are more curious about the facts of nature than they are during the high school age when the activities of young people are more distinctly social. There seems to be no valid reason for deferring all the descriptive phases of physics until the twelfth year of high school.

The laboratory method of instruction can be made a success with grade children but new methods are necessary to get results. The boys and girls are most interested in experiments which are closely related to their everyday life. A class of twenty is the

[9]Maxwell, G. E. *The Grading of Students* in *The Winona Normal Bulletin*, Series 10, Number 2, February, 1914.

maximum for laboratory work and then all pupils should perform the same experiment simultaneously. Mere busy work of nature study character is not to be desired. The natural interests of the pupils often lead the instructor into new and absorbing discussions. The teacher is often put to the test to devise simple, accurate, explanations of many honest questions. This is far more true of grade pupils than with high school people. The interest in the experiments selected was sufficient to cause pupils to repeat several of them of their own accord on Saturday.

On the completion of such a brief course, one may reasonably expect the child to know, (a) How to perform simple experiments without excessive personal direction. (b) How to cooperate so that a large class can work in the laboratory. (c)

TABLE III.

Summary—Table Showing Grades for Both Boys and Girls.

		I.	Wattmeter.	34	59	86.8	92.2	77	27	35	36	40	42
				36	51	76.5	80.5	71.1	16	64	33	34	51
		II.	Levers.	99	100	100	100	100	100	97	100	99	100
				100	100	100	100	100	100	100	100	95	100
		III.	Pulleys.	70.9	86.8	92.2	77	81.3	86.7	81.6			
				76.1	76.5	80.5	71.1	86.9	81.1	78	77.3	71.6	
		IV.	Weighing.	12	11	9	29	30	29	32	29	29	
				21	19	21	33	33	33	33	26	26	
		V.	The Bunsen Burner.										
		VI.	Effect of Heat Upon Water.										
		VII.	Effect of Heat Upon Air.										
		VIII.	Conduction of Heat.										
		IX.	Magnet Poles and Compass.										
		X.	Magnetic Fields.										
		XI.	Sal Ammoniac Battery.										
		XII.	Electro-Magnet.										
		XIII.	Electric Bell.										
				Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
				Lowest Grade		Highest Grade		Average Grade		Number of Pupils			

The magazines, *Scientific American, Popular Mechanics, Popular Electricity,* etc. (d) How to write a report on an experiment, at least as regards form. (e) Names of common pieces of apparatus and instruments. (f) Several good books which tell how to make various things in which a boy is interested. (g) Something concerning the lives of James Watt, Lord Kelvin, Faraday, Davy, Gilbert, Archimedes, Volta, Ampere, Dewar, Galileo, etc., and the great American inventors.

There is great need for simple, accurate and interesting accounts of the great men of physics. Much oral instruction, including accounts of the experiences of scientists and inventors is needed for such pupils but this must be given largely as a result of questions and from a rather complete store in the mind of the instructor. The questions aroused were numerous and those that the author, during all his experience as a high school instructor, has been wishing to hear voluntarily expressed by pupils.

The short weekly tests taught habits of neatness in preparation of papers, and were valuable alike to pupil and instructor in the process of instruction. These graphs have shown us what modifications and improvements to make in the course under consideration and are submitted without apology. However, no exaggerated value is placed on these tests, even for our own use; no one can appreciate the crudity of the work more than the author but anyone who sincerely wishes to contribute positively or negatively to the best practice in science teaching will try earnestly with open mind to find solutions for a few of the innumerable problems of instruction in physics.

TWO QUEER STATEMENTS.

In Volume 10 of the eleventh edition of the *Encyclopedia Britannica*, under the word Fermat, there appears the following statement: "He died in the belief that he had found a relation which every prime number must satisfy, namely $2^{2^n}+1=a$ prime." It is very evident that most of the small prime numbers are not of this form. In the noted French encyclopedia, called *Nouveau Larousse* there appears, under the word substitution, the following statement: "The notion of group due to Galois has opened a vast field." Every one ought to know that the notion of group is much older than the work of Galois. As these statements appear in works which are generally regarded as very reliable they are of especial interest.

G. A. MILLER.

INSTRUCTION OF YOUNG PEOPLE IN RESPECT TO SEX.

By T. W. Galloway,
James Millikin University, Decatur, Ill.

During the last year or so there has been a certain reaction against the movement to use the facts of sex for constructive educational purposes. It is being said that we are making a great mistake in departing from the reticence of the past, and in dragging the sex matters into the light. The movement of reformers and eugenists and educators to give sound information of a scientific sort respecting sex is being coupled by some people with the lack of restraint shown in the vaudeville, the picture shows, the drama, and in much of the fiction of the times. This coupling of these two impulses toward more free handling of the sex theme is thoroughly superficial. We shall hope that it is not sinister. The motives producing the plea for publicity in the two cases are absolutely opposite.

While in my opinion this reaction is destined to be temporary, it has come to pass that a speaker on the subject just now does not feel quite sure where his audience is located.

I. *Introduction.*

By way of introduction, therefore, I shall state without argument a few general propositions which otherwise might be taken for granted. In what I shall say I have in mind primarily the work of teachers and schools in reference to sex instruction.

1. Hunger and the need of food are perhaps the most influential forces in human life. Next to these, however, in their significance and in their influence on human life and relations are reproduction and sex. Even more than the demand for food, sex influences the fundamentals of the structure of society. The home, marriage, the care of offspring, and all the structures, habits, ideals, and sympathies arising out of these rest on sex.

2. Anything which bulks thus large in life cannot be a matter of indifference in any serious attempt to educate for life. The place of any subject, when we come fully to ourselves in an educational way, must be measured by this criterion.

3. There has long been a conscious and purposed neglect to give to the young people, for their help and guidance, the best knowledge which the race has gained in this field of life. This reticence has rather been regarded as a virtue and a mark of

[1]Read at the Spring Conference of Colleges and Secondary Schools, University of Chicago.

progress; but it has not produced satisfactory results in attitude and conduct.

4. There is a positive correlation between sound knowledge and right conduct. This means that, everything else being equal, the individuals who know the right are more likely to do the right than are those who do not know. It is well to remember this when people say that knowledge alone will not secure proper sex behavior. The order of the universe *does* put a premium on knowledge.

5. This correlation between knowledge and conduct is *not 100 per cent.* Instruction in respect to sex must be something more than merely information of the biology and pathology of sex phenomena. While this is in some respects the foundation, it is in no sense the most important or crowning part of the instruction. The instruction must reach the emotions, the social senses, the moral and spiritual ideals, and build up permanent attitudes and habits. Only in this way can the degree of correlation become satisfactory.

6. Some knowledge of sex matters is sure to come to young people. Even if ignorance were a better thing than knowledge, we do not have a choice between *ignorance* and *knowledge*. The only choice we have is as to the source and quality and accompaniments of the knowledge. Shall the information which gives first impressions of the subject come from slightly older companions and vicious servants, from the cheap shows, freighted with vulgar connotations, carried by a vocabulary that forever stamps it as vile and apart? This kind of information disturbs and incites to abnormal interest. Or shall the information come from mature people in whom the pupil has confidence, at appropriate times, graded to the actual needs of the child, and naturally related to the other knowledges which he is getting? In this event it is quieting rather than exciting, and need not at any time stand out as isolated and perturbing.

7. Instruction in respect to sex means, as was suggested above, vastly more than a few facts of the biology and pathology of sex, as some are assuming. Its problems are deeply imbedded in physical health and activity, in psychology, in all kinds of social structure and relations, in ethics, and in religion. It is not a question of drawing out detailed accounts of the sex function, its abuses and diseases, before classes of immature youth; but of organizing many of our natural instincts, impulses, and powers which we do not usually regard as connected with sex, but are

none the less so. Sex instruction means much more than to fortify the youth, through knowledge, against some of the disasters that are possible to him. It means the use of a large body of the best human attainments, ideals, relations, conventions, and emotions for definite and constructive upbuilding of individual character. By the student most of this will not be recognized as sex instruction at all; but the teacher must understand that it is such. The great inhibitors of sex abuse are not direct, but indirect.

8. This instruction must be graded to meet the actual needs of the developing individual. It cannot be imparted helpfully all at once, early in life. If it is important to grade to the capacities of youth instruction whose prime purpose is information, it is doubly true of instruction which should lead to ideals, choices, and conduct. The time of this instruction is determined by natural curiosity and interest and by need. It should, step by step, *follow* curiosity and precede the actual need. It should meet curiosity in such a way as not to arouse it further, and should meet the need without precipitating it.

II. *The steps that seem most urgent and possible.*

1. The agitation of the mature, public mind. This must be reliable, sane, thorough, and convincing—yet unexaggerated. It must produce the atmosphere in which all else must be done. It must beget a situation that will overlook such occasional mistakes as will necessarily be made in a field as new and full of perplexities as this. The public must be made willing to experiment.

2. The instruction of the present generation of teachers (and other social workers) in the essentials of the problem and of the possible steps in meeting it. This must be done by competent people through teachers' institutes, summer sessions, and suitable literature.

3. Instruction of present parents in respect to their duties and responsibilities to their children. The most hopeful method for securing this now seems to be by means of parents' and teachers' associations, mothers' clubs, and the like.

4. Instruction of *future* teachers (and incidentally future parents) in colleges, normal schools, departments of education in universities, etc.

5. Instruction in high schools in connection with courses in biology, physiology, physical training, sociology, history, literature —wherever any ramification of the subject touches.

III. *The question of instruction in the grades.*

1. The early instruction which is absolutely essential will never be given adequately in all homes.

2. The high school and college are entirely too late in individual life to meet the needs of youth. Moreover, the majority of young people never reach either high school or college.

3. The teachers of the grades therefore have a definite task which they must discover and perform—either in school or vicariously by means of other social agencies that influence the child at this period. None of these other agencies, however, are sufficiently extended in their influence to serve the necessary purpose. We cannot escape the conviction that the grades will, as time goes on, find they must contribute a good deal of the necessary materials and effort for the upbuilding of sound sex attitudes on the part of youth.

4. No school authorities should place this work formally in the curriculum until they are supported by the sentiment of their community, and have teachers who are equal both in character and knowledge to give sane and constructive guidance. While this is true it must be remembered that one of the urgent needs of the times is a series of serious, intelligent, well-considered, and well-watched experiments in this very field. Much of our unpreparedness now arises from the fact that we have not sufficient experimental results to guide us. Not until we have the accounts of many trials and results will we be in a position to know just what are the best methods of securing from the schools that contribution which they must ultimately give. In all such experimentation it is reassuring to remember that the combined common sense and skill of right thinking and right living teachers, who are fit for their positions, could scarcely fail to improve on the present use that is made of the sex impulses and the sex data in the education of our young people. It would be difficult to conceive anything, within reason, which would be worse than the present neglect, and the present crude, suggestive, misleading, and even vicious half knowledge which comes to our children.

IV. *Conclusion.*

It appears to the speaker that every right thinking individual and every social agency must be invoked: the homes; every school from the kindergarten to the university; the church and Sunday schools and young people's societies; the Christian associations; medical associations and boards of health; social workers of all

sorts; the social and educational clubs among women and men; every agency that can help supply youth with right knowledge, right motives, right standards, right feelings, right habits, right inspirations, and right inhibitions.

EXPERIMENTAL BIOLOGY OF SEX.[1]

By John W. MacArthur.
University of Chicago.

In higher plants and animals the sexual method of reproduction is so exclusively employed and plays so preëminent a role in the lives of individuals that in our dealing with *general* biological problems we are likely to overstate the significance of sex. As a matter of fact, however, sex has been at *the* centre of the problems approached by experimental methods in biology. Notable strategic footholds have been won, e. g., some ideas on the effects of conjugation in protozoa; production of artificial parthenogenesis; experimental verification of early differentiation of the germinal material; effects of inbreeding and outcrossing on vigor and fertility of offspring; knowledge of the processes of origin of some secondary sex characters; and even the laws of Mendelian inheritance—all of which are special cases dealing with biparental reproduction.

Sexual reproduction being only one of the many shifts made by protoplasm to insure successive generations of the species, it is important to recall the probable primitive state in which it was not essential that two lines of living material conjugate at the start of every life. In many cases vegetative propagations and parthenogenesis seem to be entirely adequate. In general it may be stated that pieces of organisms from certain regions of the body can re-form the whole organism; the size of such pieces has progressively diminished in phylogeny until in parthenogenetic eggs only a single cell is required; in still other forms the egg cell may not initiate its own development but such initiation is dependent upon the union of the "female" egg with a differently specialized "male" cell.

It is easily possible to arrange the modes of reproduction in a more or less continuous graded series from simple to the most complex; a plausible order of evolution of sex is thus logically

[1]Read at the Spring Conference of Colleges and Secondary Schools, University of Chicago.

devised; but whether this is the actual historical order is very doubtful.

With the appearance of essential sex organs in many-celled forms the *extent of "isolation" of the germinal material* from the more differentiated body material may be tested. The progeny of two albino guinea-pigs are albinos; a black and an albino parent have black young; if the ovaries of an albino female are removed and in their places transplanted the ovaries of a young closely-related black female, the introduced organs sometimes function normally in their new environment; in this event the albino mother mated with the albino father has only black young; showing that germ cells may not be changed by body influence (within a year).

After sex has arisen there is a further development of special body and behavior characters which are associated with one sex only. The method of *origin of* these *secondary sex characters* was in the speculative period of biology attributed to sexual selection by choice of mates, to natural selection or to differences in physiological vigor; as an example of the newer ideals of the science we may note the numerous careful investigations of the sex-psychology of many animals, and the several more physiological approaches especially through removal and transplantation of sex-organs in animals and through genetic analysis in both plants and animals.

Examples of such experiments will be given. Marine spider-crabs may be parasitized by a barnacle-like crustacean whose tumoroid roots penetrate the abdomen of the host and destroy the gonads; the females retain their female characters but males assume female characters of abdomen, claws and swimmerets. Removal of ovaries from a Brown Leghorn hen is followed by gradual assumption of male plumage. If male sheep or deer of those races where males only are horned be castrated further development of horns is inhibited; females thus castrated do not produce horns. The sex characters including behavior of young rats or guinea-pigs may be entirely *reversed* by castration and subsequent transplantation of sex-organs of the opposite sex. For instance, a castrated male with ovaries introduced under his skin or on the walls of his abdominal cavity grows up "feminized," having all the characters of the sex-determined adult female, such as: more delicate skeleton, low body-weight, short, slender form, fine soft hair, well-developed mammary glands, and instinct to suckle young and all other feminine sex and parental

instincts. This well illustrates the potency of internal secretions as factors in vertebrate physiology.

Vast numbers of experiments have been conducted to discover the *mechanism and means of control of sex-determination*. Statistics show in most well-known organisms that the numbers of individuals of the two sexes are approximately equal (or at least constant). Can this constant ratio be shifted by any known means? (a) *External conditions* such as food, temperature, humidity and chemical medium, have not been shown to be effective in altering the proportions, except by providing conditions in which one sex is less fitted to live than the other.[1] (b) The supposed influence of the age, race, class of society, "vigor," or degree of relationship of *parents* is certainly illusory. There is no correlation of one sex with origin of germ-cells from one (right or left) gonad. The time of conception and degree of ripeness of germ-cells may be of some importance. That sex may be somewhat quantitative and mutable in its essence is indicated by the data derived from instances of forced and continuous reproduction where the order and number of young point to metabolic sex-differences; the Oriental dove mated with male white dove has black (male) young and white (female) young; the eggs are laid in pairs; if these pairs are removed from the parents as fast as laid and hatched, they produce squabs as follows: in spring, black males; in early summer, black males from the first (small, watery) egg and white females from the second (large and fatty) egg; late summer and fall, white females; late fall, weaker individuals, until the last pairs fail to hatch at all. (c) A decade of genetics has contributed much valuable data by showing which sex transmits both maleness and femaleness (is "heterozygous for sex"). In the guinea-pig black-white cross whether the father or the mother is the black parent, the young are similarly black. In many cases, however, it does make a difference which parent contributes a character for such character may be *"sex-linked."* That the male is heterozygous for sex is indicated by inheritance of color blindness in man; a color-blind father and normal mother have normal children, but a color-blind mother and normal father have color-blind sons and normal daughters. Fruit-flies and such hermaphroditic plants as bryonia have males heterozygous. That either sex (female in birds, male in crabs)

[1] In some lower animals, as the Rotiper, better evidence is now forthcoming showing strong effect of nature of food on the proportion of sexes. External conditions of life certainly do influence also the methods of reproduction, optional environments proving continued asexual propogation and extreme and degressing conditions sexual reproduction.

may be heterozygous, is indicated by the castration experiments; that it is the female in birds and the current moth is shown through sex-linked inheritance. (d) Since external and parental environments are without direct influence on the sex of offspring we must look in the organization of the germ-cells or in the fertilization process for further light. Are there two kinds (as to sizes or number of chromosomes) of eggs or sperms? Since parthenogenetic eggs in nature may make males (as in drone-bees) or females (as in daphnids), the question as to what will be the sex of fatherless frogs and sea-urchins reared from artificially fertilized eggs becomes of absorbing interest.

BALSAM FIR NOW IN DEMAND FOR PAPER PULP.

That balsam fir, a tree which a few years ago was considered of little value, is now in demand for pulp wood, is the statement made by the department of agriculture in a bulletin just issued on the subject. This demand has been brought about, says the department, by the enormous expansion of the pulp industry during the past two decades, with its present consumption of three and a quarter million cords of coniferous wood and the consequent rise in the price of spruce, the wood most in demand for paper-making. In addition, the department goes on to say, balsam has begun to take the place of spruce for rough lumber, laths, and the like, as the price of the latter wood has risen.

The chief objection to the use of large amounts of balsam fir in the ground-pulp process of paper-making is said to be due to the so-called pitch in the wood, which injures the felts and cylinder faces upon which the pulp is rolled out. Balsam fir does not have a resinous wood, and the material which gums up the cylinder probably comes from grinding balsam under conditions adapted to spruce wood. Yet from ten to twenty-five per cent and possibly more of balsam can be used in ground pulp without lowering the grade of the paper produced. It is known that with balsam logs left lying in water over a season this drawback practically disappears.

In chemical pulp, produced through the action of acids, these acids are known to dissolve the pitch, and any amount of balsam can be used, though some claim that too much balsam in the pulp gives a paper that lacks strength, snap, and character.

At the present time, balsam fir furnishes about six or seven per cent of the domestic coniferous wood used by the country's pulp industry. The tree itself constitutes, numerically, about twenty per cent of the coniferous forest in northern New York and Maine, and is abundant in many parts of New Hampshire, Vermont, and in the swamps of northern Michigan, northern Wisconsin, and Minnesota. It readily reforests cut-over areas, and attains a size suitable for pulp wood in a short time.

Under present methods of cutting, balsam fir is said to be increasing in our second-growth forests at the expense of red spruce, and with the gradual decline in the supply of the latter wood the fir will become more and more important commercially.

THE PROBLEM OF THE LOADED TABLE: A REJOINDER.

By Ernest R. von Nardroff,
Stuyvesant High School, New York.

The May issue of School Science and Mathematics contains two replies to my discussion of the "Problem of the Loaded Table," which appeared in the March issue. This problem was stated thus:

"A table 3 ft. by 4 ft. has a leg at each of its four corners, A, B, C, and D. The table supports a load of 120 lbs. at a point 1 ft. from the long side, AB, and 1 ft. from the short side, AD. What is the pressure due to this load at the foot of each leg?"

The first of these replies, entitled "The Loaded Table Again," claims to present a solution of the problem by means of moments alone. As the results happen, with the particular numbers used, to agree approximately with those in my article, the hurried reader may possibly assume that the author's reasoning is correct. However, the reasoning will readily be seen to be quite fallacious; if it be applied to equation (2) instead of to equation (4) a very different set of results will be obtained. Undoubtedly the problem can not be solved by moments alone.

In the second reply, entitled "Reply to Problem of the Loaded Table," the author succeeds in solving the problem by an alternative method in which he employs the well known principle that states that stable equilibrium in any system occurs only when the potential energy is a minimum. He definitely assumes, as I did, the law of elastic yielding commonly known as Hooke's Law, and by his different method of calculation corroborates my results. So far we are in perfect agreement, but at the next point we part; while the author maintains that all elastic yielding, without exception, follows Hooke's simple law, I maintain that other, and much more complicated, laws are commonly followed with ordinary tables resting on ordinary floors. I will endeavor to make my position clear.

Suppose that our table were placed upon a floor consisting of a pool of mercury and that the legs are broad cylinders. The legs will sink into the mercury to depths proportional to the local pressures, which will be those calculated on the basis of Hooke's Law But suppose the legs are wedges with sharp feet. In this case the legs will sink to depths proportional to the square root of the local pressures. And if we suppose the legs are cones we must conclude that they will sink to depths proportional to the

cube root of the local pressures. Now, does not something analogous to this occur when an ordinary table, provided at its feet with the convex polished steel shoes called "Domes of Silence," rests on a wooden floor? The wood under a steel shoe yields elastically while the load is being increased, and the shoe comes into contact with an increasing area of wood. The shoe thus encounters a resistance that increases more rapidly, certainly, than does the depth of yielding. Hooke's Law may, indeed, be approximately obeyed by each elementary volume of wood, but it is certain that in this case the integral effect departs very far from this law.

Consider, next, two types of elastic structures found in spring mattresses. In the "spring mattress" there are many vertical springs. A load placed upon such a mattress will sink very nearly in accordance with Hooke's Law. But in the "wire mattress" there are at the foot and head a number of horizontal spiral springs supporting a wire tissue or mesh. If the spiral springs were adjusted to zero tension when there is no load, then when a load consisting of a heavy transverse bar is placed at the middle of the mattress the latter will yield vertically to an amount approximately proportional to the cube root of the load. A floor consisting of thin boards nailed firmly to stout cross beams partakes in part of the second type of bed mattress. A load placed midway between two beams causes the floor board to sag and thus to bend and to stretch. The vertical reaction to bending will closely follow Hooke's Law, but the vertical reaction due to stretching will be proportional approximately to the cube of the vertical yielding. A little thought will show that with such a floor and with a rigid table the relation among the pressures at the feet will be a variable relation depending upon the absolute value of the load and upon the value of Young's modulus. With an infinitesimal load or with an infinite value of Young's modulus the total yielding in this case would, as a limit, follow Hooke's Law, but not otherwise.

Let us look more closely at the table itself. Let us suppose, as the author does overtly, that the floor is perfectly rigid, and let us suppose, as the author does tacitly, that the table top is perfectly rigid. But let us suppose that the table legs have unequal cross sections. Clearly, this disturbance of elastic yielding will result in a new set of pressures at the feet of the table. However, as it will be urged that this table is not symmetrical, let us suppose that the legs have equal cross sections and that in every

other way the table is perfectly symmetrical, but that, instead of being perfectly rigid, the top is a flexible sheet of wood. On account of this flexibility the legs far from the asymmetrically placed load will be relieved in part from the share they bore when the top was rigid, and, correspondingly, the nearer legs will support a greater share than before. Further, this flexure yielding, while possibly nearly obeying Hooke's Law for each separate corner of the table top, does not bear the same proportion to the pressure at one leg as at another and, hence, the distribution of pressure will depart very greatly from the distribution calculated on the simple assumptions at first considered. The case resembles that with the legs of unequal cross sections.

Clearly, then, if in our original problem an ordinary symmetrical table asymmetrically loaded rests upon an ordinary floor, the distribution of pressures at the feet is not unique, but depends upon the design of the table and of the floor, and even, in some cases, upon the absolute amount of the load and the value of Young's modulus.

EXPERIMENTS.

By Edwin H. Hall,
Cambridge, Mass.

1. A teaspoonful of sand is dropped into a jar which is two-thirds full of water and then the water is vigorously stirred, always in the same direction, till it is in a state of rapid rotation. Where will the sand be when the water comes to rest?

To Illustrate the Stability of Ships.

2. According to naval writers a ship is said to be "stiff" if she has the power of returning quickly to the upright position after being inclined, and a ship is said to be "steady" if she has but little tendency to roll when broadside to waves. The qualities of stiffness and steadiness both seem desirable, and it may naturally be thought that they are substantially the same. In fact, they are very different, if not strictly incompatible. A ship which does not roll in waves that come broadside on is like a log, indifferent as to which side up she floats. A stiff ship acts like a floating board, keeping her deck nearly parallel with the surface of the water just beneath her, and so changing inclination violently when high waves pass beneath her, but without danger of turning over.

Figure 1 represents the side view and Figure 2 the end view

of a cylinder of wood, about 10 cm. long and some 4 cm. in diameter. P is a tall pin projecting upward from the cylinder at its middle, carrying a strip B of black paper parallel to the length of the cylinder and a strip W of white paper at right angles to B. S is a heavy-headed screw which is driven into the cylinder to such a distance as to make it almost unstable, laterally, when

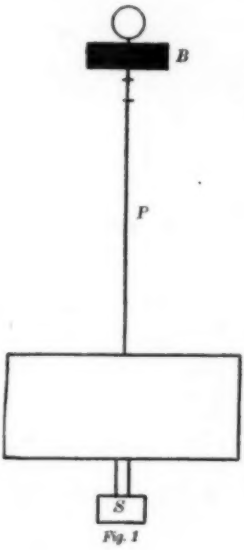


Fig. 1

Fig. 2

floating in water. Longitudinally, however, the cylinder is very stable. When the whole affair is floated and the water near it is smartly agitated, the movements of B, indicating pitching of the cylinder, are much more conspicuous than those of W, indicating rolling, though the danger of overturning laterally is vastly greater than the danger of overturning longitudinally. The cylinder is stiff as to pitching and steady as to rolling.

AN AERODYNAMIC PARADOX.

By Edwin H. Hall,
Cambridge, Mass.

Comparatively early in his experiments on the principles of flying Langley discovered that a light plane, properly inclined to the horizontal, could be sustained in the air and drawn through it with great velocity by a horizontal pull less than the weight of the plane. He was greatly impressed by this rather paradoxical fact, which is obviously of great importance in the economy of flying. Figures 1, 2 and 2′ illustrate a device for showing it in a lecture-room experiment. In Figure 1, P is a rectangle of pasteboard, 20 cm. long, 7 cm. wide, and about 0.06 cm. thick. The wings, w and w, which in use are turned at right angles with P, along the dotted lines, may be somewhat thinner. In Figure 2 the

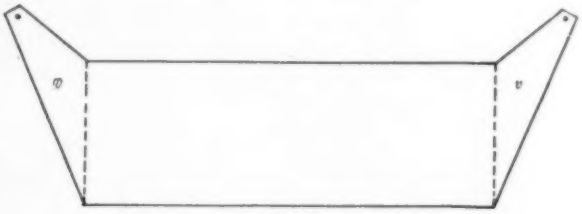


Fig. 1

wings are at right angles with P and are pierced near their tips by an aluminium wire, a, about 0.1 cm. in diameter. This wire, and with it P, is suspended by means of two threads, t and t, from the ends of a pasteboard beam, B, hung on the spiral spring, S, which is attached to the rod R. The threads, t and t, touch lightly the two pulleys, p and p, which consist of pasteboard pill-boxes, furnished with flanges on each side to keep the threads in place when P is agitated by a current of air. The pulleys turn very easily on the rod, R. The whole suspended apparatus is borne by the wooden support, WW. The parts carried by the spiral spring weigh about 15 gm. and their mere weight stretches the spring about 15 cm., holding the ends of B about 2 cm. below the stops s and s. Figure 2′ shows a side view of the apparatus, with the frame cut away, when a brisk current of air is blowing in the direction of the arrow, A. The pull of the threads upon P is now horizontal, and it is evidently less than the weight of P, for the beam B now hangs higher, by the distance D, than it hung in Figure 2. The ends of B are, in fact, now pressing upward against the stops s and s of Figure 2.

The chief difficulty in operating this apparatus is found in providing a suitable horizontal current of air. A small fan-motor gives velocity enough, but of course it gives a rotating current, which prevents equilibrium of P. I have sought to suppress this

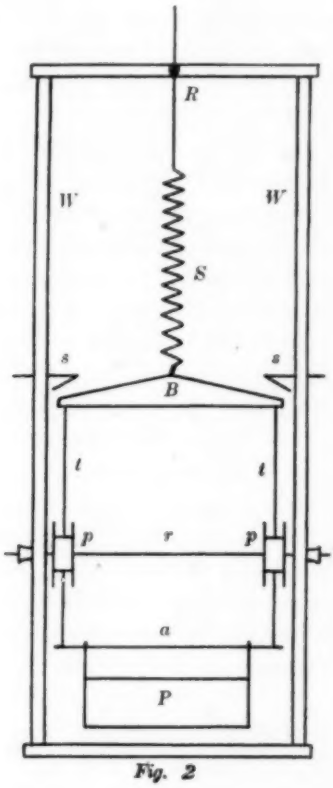


Fig. 2

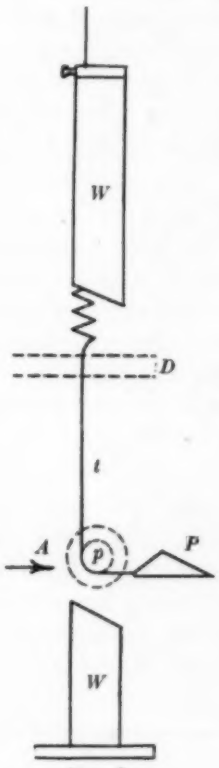


Fig. 2

rotation, and have been reasonably successful, by making the air approach P, from the fan, through a bundle of straight paper or pasteboard tubes, about 75 cm. long and 6 or 7 cm. in diameter.

In showing this apparatus to a manufacturer I have suggested that it should bear Langley's name. It might be called the Langley *Paradox*.

THE HIGH SCHOOL PHYSIOLOGY PROBLEM.

By Raymond W. Fairchild,

State Normal, Stevens Point, Wis.

The problem presents itself under three natural divisions—(1) How shall the subject be presented to the class; (2) In what year of the course shall it be taught; (3) Shall the subject be required?

In this, as in all natural sciences, it is never possible to have the whole of the facts before us. Even if we could collect and correctly arrange all the data on this particular subject, the outermost bounds would still remain uncertain, and this no matter how far our researches might extend, unless these bounds compassed all reality, which is impossible. It is, therefore, the intention of the writer to discuss some difficulties and attendant weaknesses that are most apparent after several years' experience with these difficulties in high school physiology.

As it is not within the scope of this discussion to show a need or desirability for physiology, it is taken for granted that this subject is offered in practically all of our high schools. The varied conditions in the many high schools which make the problem complex are best shown in the accompanying table. This table was compiled from answers to a questionnaire sent out to some of the average and large sized high schools of the middle west and for this authentic information from various sources the writer is deeply indebted to a number of individuals.

State.	Total Schools considered.	Schools offering Physiology.	Schools not offering Physiology.	Schools requiring Physiology.	Position in four year course.				Offering a Gen. Science Course.			Offering neither Physiology or General Science.
					First year.	Second year.	Third year.	Fourth year.	Same year or preceding Physiology.	Without Physiology.	Total.	
Illinois	48	37	11	2	26	7	3	1	3	3	6	5
Iowa	19	17	2	3	10	3	3	1	1	1	2	1
Wisconsin	17	17	0	3	9	6	2	0	2	0	2	0
Indiana	12	11	1	1	8	1	2	0	3	1	4	0
Michigan	12	9	3	2	4	3	2	0	1	0	1	2

In addition to the phases of the problem as presented by the above statistics, there are side issues upon which the solving of the problem seems to depend. As one of these side issues indirectly shown in the above table, let us determine how the subject shall be presented to the class.

METHOD OF PRESENTATION.

In our high schools today, under the subject name physiology, various subjects and methods of treatment are found such as hygiene, anatomy, physiology or a combination from the three. The purpose of the course must be determined at the outset and naturally this brings up the comparative merits of each of the above three divisions. Following the path of least resistance we might suggest teaching a combination of all three. However, after careful thought any selection of the phase of work to be taught resolves itself into: (1) a study of the needs of the community; (2) the time available for the subject; and (3) the place in the course. The needs of the community are best shown by the prevalence or absence of unsanitary conditions and disease. In some communities the great need, and the only thing that will accomplish the purpose in the shortest space of time, is a good course in hygiene and sanitation. Generally speaking, however, where the demand is not so decidedly apparent, a good course in physiology, with as small amount of hygiene and anatomy as consistent, has the greatest permanent value. Some work in hygiene and sanitation should have been given in the seventh and eighth grades and is then to be followed, *not* by more hygiene but by physiology in the high school. The advisability of such is easily evident when the nature of the average child is considered. Hygiene presupposes much and lays down certain well constructed laws but fails to answer the question of "why" to any appreciable extent. These laws the child of twelve or thirteen years in the seventh and eighth grades does not question at the time but soon the question of "why" confronts him. If there is a reason for these things he wants to be shown. Here is the great value of physiology in the high school. A writer on the subject of sex education recently made the statement, "Heretofore, too much physiology and not enough hygiene has been taught in our schools. Rather than have the pupils acquire a mass of knowledge concerning the circulation of the blood, the coats of the stomach, the construction of the eye ball, or the arrangement of the various parts of the brain, is it not more practical for them to know why milk is such a splendid food, what shoes are hygienic, and why; how to act in such emergencies as fainting, nose-bleed, and drowning; the germ theory of disease, and the intelligent use of disinfectants?" Most persons will agree that it is important to know why milk is such a splendid food but does not that knowledge involve a knowledge of tissues and their relation to such foods as milk?

Also a knowledge of what digestive juices act on the different compounds of milk such as the fats, sugar, and proteid, is quite essential. Thus is physiology, and not hygiene, the ultimate basis of our knowledge. Apply the same idea to "hygienic shoes" and where do we find a better reason for this type of footwear than in the fact that the bones are so constructed from the standpoint of mineral and animal matter and so used that often they may assume an unnatural form. Is not this likewise essentially and ultimately physiology? Apply this idea to all the other phases mentioned in the above statement and without exception it reverts back to a knowledge of the structure and use of the human body. Hygiene is not a series of hypotheses but a series of problems to be proved from application to other divisions of the work and in final and complete form should follow and not precede this work. Hence we are led to conclude that in the average community and in teaching the average American child, some foundation for hygienic statements is desirable and we must fall back to the use of the human body—the physiological side.

The time generally allotted to physiology is one semester and this generally meets the needs of the work, especially when only essentials are covered. However, some classes in the subject meet but three times a week. Again another class in a different school meets five times a week while still another school insists that the class meet three single periods a week for recitation and two double periods for laboratory work. It is readily possible to accompany the text work by very profitable laboratory exercises. A plan for this, however, is not within the scope of this particular article. Whichever method is followed, a practical application of the work is always possible if most of the time is spent on the functions of the body. Physiology can be taught by all types of schools to better advantage than merely hygiene or anatomy, in the limited time available, since it is generally accepted as a "foundation" subject easily confined to certain definite boundaries.

As to what we shall teach as influenced from the standpoint of the position in the course, your attention is directed to the next or second general phase of this article.

Position in the Program of Studies.

This is a matter of great diversity ranging from the first to the last year of a high school program of studies. It is interesting to note how far we keep away from the recommendation of the

Committee of Ten. Permit a quotation from their report on the subject of physiology. "It is the judgment of this conference that, while the principles of hygiene should be included in the works of the lower grades, the study of physiology as a science may best be pursued in the later years of the high school course. We recommend that a daily period for one-half year be devoted in the high school to the study of anatomy, physiology and hygiene, with as large an amount of practical work as is possible. The study of physiology is in a great measure the study of the mechanics, the physics, and the chemistry of the living body; before it can be pursued profitably the student should have, at least, a fair elementary knowledge of these sciences as fundamental. It is not possible to teach it as a science to pupils devoid of such knowledge; any effort to do so is apt to lead either to the bewilderment of the learner, or else to attempt at "simplification" on the part of the instructor which convey erroneous ideas unless the teacher has exceptional knowledge and skill."

From the foregoing table, (Page 688) showing the position of physiology in the course of many of our leading high schools, it would not appear that the recommendation has had much influence. Many persons agree that the work should undoubtedly be given in the third or fourth year but that it was difficult to get another subject to use as an elective in the first or second year. Others have contended that to place physiology in the third or fourth year would demand a change in position of chemistry and physics in the course or a crowding of those subjects and physiology in the same two years. But now a new light is cast upon these difficulties—a light which promises to surmount all past and present difficulties so far as the place in the program of studies is concerned. This new light is an elementary general science course, universally offered in the first year of a four year high school course. Among many of the qualities claimed for such a course is that it stimulates and increases interest in science and also forms a basis for higher sciences. Thus we have a subject that will give enough chemistry and physics to enable the student to better accomplish a high grade of work in physiology and give much of a necessary incentive for him to take the work where it is elective. As an introduction to physiology, general science is excellent; as a substitute it is poor and insufficient to meet ordinary needs. In but few schools is it offered alone but generally as a foundation for other science work. As it usually covers a semester's time, opportunity is given for the placing of

physiology in the second half of the first year or even in the second year. Thus it is possible to comply with the recommendation of the Committee of Ten as regards the previous knowledge of some physics and chemistry and at the same time be able to place it in the first or second year of the program of studies, removing the difficulty of getting another subject to use in the early part of the work. Some knowledge of physics and chemistry is needed to thoroughly understand and obtain the greatest good from physiology and if a general science course cannot be offered, physiology should not be offered until the third or fourth year's work. Such a position has its merits, chief of which is the fact that fourth year students are not thrown in the same class with first year students. Where the subject is elective and offered in the first year, the class often has as many third and fourth year students as those of the first two years. This is largely due to the subject being elective and with requirements completed near the end of a course, the students look for elective work they have passed over. Then again, many students decide they want to teach and feeling the need of some physiology in preparation for a teacher's examination decide to take the subject in their last year. Thus the teacher of physiology which is offered in the first year has the difficulty of making the work simple enough to be clear to the first year student and not too simple as to be uninteresting to the fourth year student. Here is seen a great advantage in placing physiology in the last year of the program of studies. Our conclusion would be that if offered in the first or second year, physiology should be preceded by general science; if no general science is offered the work should be given in the third or fourth year. The latter plan seems the better even though general science is offered as it reduces the complication in enrollment and instruction.

Physiology as a Requirement.

There is a tendency today, and indeed a growing tendency, to force physiology into the background. This can be attributed to the fact that it is not generally a required subject, and, as an elective, does not receive proper consideration from the student or encouragement from the supervising or advisory faculty member or members. The reasoning of both student and registering officer appears to be much the same and generally centers around the question, "why study anything so common when more valuable subjects are offered." "That can be studied as outside work"; or "enough is already known for all ordinary use." "Let us

take zoölogy or botany." And so there is no surprise when a class of seven or eight "unfortunates" appear who were condemned to this unpleasant condition due to conflicts in their program of studies. Little is it realized that proper study of any and all subjects is dependent upon a knowledge of the use of the human body. Even from the proper use and care of the eyes to the recognition of the complexities of all parts of the body requiring exercise and rest, physiology is essential. But let us take a little broader view of the subject. To become acquainted with a bit of complex machinery such as an automobile engine for example, literature would be purchased on the subject or verbal instructions would be followed accurately; but no such interest is apparent when the complex mechanism of the human body is considered. Such inconsistency and self-satisfaction can only result in a physical and mental weakening of any race and will offset anything in the way of directions and aids that sanitation and hygiene may have to offer. Why not follow the maxim of the ancient Greeks of—"Know thyself?" It is deplorable how little the high school student knows about the human body and its use and care. And yet all fault for this must not be placed on the student for it is not his dislike for the subject so much as it is lack of guidance, when he eagerly seizes upon what appears to be a "modern" subject in preference to "such a common subject." In several courses of study a compromise has been introduced whereby the student is given his choice of physiology or some other one subject. In many others the election is a choice of physiology from as many as five subjects as manual training, domestic science, botany, physical geography and agriculture. It is only natural that the subject without even so much as a recommendation to the student should be pushed into the background. These are conditions just as they appear in most of our high schools today and if the present may seem dark and the attitude unintentionally pessimistic, the future holds much in store in the way of bettered physical conditions for the high school student whose choice of studies is made to include physiology. Few students entering physiology regret having gone into the subject, if experience with different classes and statements of several physiology teachers is any evidence. The answer of many critics of required physiology is that we require too much now and there is not room for it as a required subject. Moreover it is contended that the student gets sufficient physiology in the grades where it is required. This so-called "sufficiency" is required in but few states

and where required only covers a period of from six to ten weeks, dwelling chiefly on public hygiene and sanitation. While this is a much-needed phase of the work, it does not answer for a study of the human body, the abode of the child's mental and physical ability. If we must not increase our required studies the situation seems to resolve itself into a question of the advisability of building up superficial layers of English, algebra and other requirements at the expense of a knowledge of the thing most precious to the individual—the acquirement and maintenance of a healthful body. Shall we place a knowledge of the phases of prescribed courses of study superior to the working knowledge of our own bodies?

If physiology has not been required in the past, then the demand is all the more urgent with our present day height of civilization. Physiology, at present, is only asking for a place on an equal footing with other subjects, but the time will come, and in the not distant future, when the plea will resolve itself into an absolute demand. Shall we await this condition of affairs or shall we, in anticipation of this action, act accordingly and be reaping the harvest of bettered physical and mental conditions that will aid in the improved work in all studies?

MEDICAL INSPECTION.

"No educational movement in modern times has had more vital relations to the children, to the homes they represent, and to the nation, than medical supervision of school children and the general hygienic movement it typifies," says Dr. P. P. Claxton, United States Commissioner of Education, in a bulletin on medical inspection just issued for free distribution by the Bureau.

The bulletin is an "annotated bibliography" of medical inspection literature during the past four years. It was compiled in the division of school hygiene and sanitation. It shows health conditions among school children in a number of different localities, thus making it possible for one community to find out readily what another community similarly situated has accomplished in solving health problems in the schools. The most significant reports that have been presented for various typical localities are summarized for reference.

Among the topics treated are: Medical inspection of the eyes, ears, nose and throat; dental clinics; training of school nurses; salaries of school medical inspectors; medical inspection records, etc.

In his introduction Dr. Claxton points out that "although the work of medical inspection began in the United States less than 20 years ago, we are now in the midst of the most rapid development of this part of the public educational service."

SOME OBSERVATIONS ON THE STUDY AND TEACHING OF MATHEMATICS IN GERMANY.[1]

By Professor G. N. Armstrong,

Ohio Wesleyan University, Delaware, Ohio.

Accordingly, any one who is here expecting to hear a scientific or exhaustive discussion of the study and teaching of mathematics in Germany is doomed to disappointment and will doubtless feel poorly repaid for remaining. For such I would suggest that classic by Professor Young on the teaching of mathematics in Prussia. (*The Teaching of Mathematics in the Higher Schools of Prussia,* J. W. A. Young. Longmans, Green & Co., 1900. 80 cents.) The worth of this book is recognized abroad. Direktor Thaer of Hamburg told a friend of mine who was visiting schools in Germany last year that he considered it to be one of the best short discussions of the subject that he knew anything about, and that he always required his Kandidaten (normal students) to read it. While almost fifteen years old now it seems to me to need very few corrections so far as my knowledge goes. For anyone who wishes to go into the subject exhaustively there is a wealth of material in very accessible shape in the Schriften des Deutschen Unterausschusses der Internationalen Unterrichtskommission—the I. M. U. K. they call it. The six volumes, with more than 3700 pages, cover the field with characteristic German thoroughness and completeness. Two sections which are especially to be recommended are by Dr. W. Lietzmann, a teacher in the Barmen Oberrealschule, and are: *Stoff und Methode im mathematischen Unterricht der Norddeutschen höheren Schulen, mit einem Einführungswort von F. Klein* (102 pages); and *Die Organisation des mathematischen Unterrichts an den höheren Knabenschulen in Preussen* (204 pages). All of these reports are published by Teubner, Leipzig.

In consenting to appear upon this program with a subject to which I have in no wise given special study I decided that it might not be without some profit and interest to present two different things, namely some random personal observations upon persons and things connected with education among my associates and associations while studying abroad and, secondly, to present the mathematical autobiographies so to speak of some of the mathematical acquaintances I made. I wrote to them making request for the data. They all responded quite graciously and also as in-

[1]Extracted from a paper read before the Ohio Teachers of Mathematics and Science at Columbus, O., April 4, 1914.

telligently, I suppose, as they were able to divine my wishes. I have attempted to put these into English and later will present selected parts.

It may be well to present first this outline of the southern German school system, which was prepared for me by one of these friends. While the facts are familiar to the most of you, it may be well to refresh your memories to make more intelligible some of the succeeding parts of the paper. The writer is the assistant to one of the professors at the Technical High School, Munich. He studied mathematics four years or more at the University and the Technical High School and then got this assistantship after taking his doctor's degree. His duties are to attend the professor's lectures, to correct all written exercises and examinations, make up some of the problem papers, conduct many of the quiz and problem periods, do all of the clerical work, and in fact practically all of the routine work. In addition he is librarian of the departmental library and model collection and assists the professor some in his revisions and editorial work. The salary of an assistant is 1800 marks ($432) per year—not counting reduced rates at the royal theater. This young man frequently had anxiety as to what he should do this next year, for it is the policy of the Technical High School not to keep an assistant more than three years. He felt the pressure, which so many talked to me about, of the surplus of the educated classes, what Bismarck called the Abiturientenproletariat ("beggar graduates"). More than once did I hear war excused on the grounds that it made better opportunities for those who survived. He says:

"I regret to say that I cannot be of much use to you in your request for my school experiences. I attended a type of school which was discontinued shortly after I finished as being impractical to use. This was the so-called Industry School. There were made out of it the Bavarian Oberrealschule as a continuation and strengthening of the theoretical part, and the Bavarian Technikum in Nuremberg, in which the technical branches, such as machine and building construction and chemistry, were extended. There would be no point to talking about an abandoned system of schools. Furthermore, I have been out of the schools for eight years, have not concerned myself with them and do not know anything about the progress they have made in the course of time."

The "full-class" intermediate schools of Southern Germany have nine years of instruction. Four years of the Volkschule

precede. Of these intermediate schools there are the following:

Humanistische Gymnasien Realgymnasien Oberrealschulen	After completing the sixth year of these schools the student is excused from one year of military service.
Realschulen Progymnasien Lateinschulen	These have six years of instruction and also reduce the time of service one year.

The Realschulen and the Progymnasien do the same work as the "full-class" schools in the first six years.

Outside of the above institutions there are many special schools, such as industrial schools, technical schools, agricultural schools, trade schools and business schools.

As remarked before I never saw a German school in action. In Prussia one must get permission to visit the schools from the government at Berlin through our ambassador. It is not always easy to accomplish this in short order. In Bavaria the difficulties are not much less irksome and the furthest I got was to roam through some buildings after school hours, to visit some laboratories in order to see the work of a teacher who taught physics with apparatus made by his pupils, and to attend one teachers' seminar with Dean Minnich of Miami University. The following remarks then are merely incidental and not the result of formal study of the question.

One of the first German boys I got acquainted with was M—, dentist's son, aged about nineteen, a Primaner in the Göttingen hum. Gymnasium. He walked with me and talked with me and patiently listened to me all for one mark per hour. He impressed me as being very bright, although he was not the Primus of his school class. He appeared to be having school and then again a vacation at the most unexpected times. He seemed to know things—yes, actually know them—not merely to be loaded up with facts to deliver at some examination or recitation and then get rid of them. When we could not make a connection through German or English he was quite ready to use Latin. He knew a good deal about our history. It was interesting to hear him tell about the Revolutionary War, about Uncle Tom's "Hütte" and about our old friend Natty Bumpo as Lederstrümpfe. He took me through their building after school hours. It was well built, but the seating did not seem to come up to our standards, the number of pictures and busts of the Kaiser in the rooms attracted my attention, and I could not understand how they got along with the little four by six-foot blackboards. When he explained to me

Outline of the School System of Southern Germany.

Volkschule.

(From the 6th to the 14th year, that is in *eight one-year* classes; then the Continuation Schools up to the age of 18.)

From the fourth year of the Volkschule the pupils go either to

Realschule, 6 years.	Lateinschule,	Progymnasium, 6 years.
(The Realschule does the work of the first 6 classes of an Oberrealschule.)	Has only 5 classes, which correspond to the first five classes of a Progymnasium. This school has no great force.	Does the work of the first six classes of a humanistic gymnasium.

The Realschule and the Progymnasium courses fulfill the requirements for one-year military service.

A business school may be joined to the Realschule for educating for business.

Those finishing the Realschule if they wish to enter technical occupations go on to a Technikum, a buildings-trade or a trade school.

Oberrealschule,	Realgymnasium,	Human-Gymnasium.
——— Nine years' instruction. ———		
French	French	French
English	English	Latin
Diff. and Int. Calculus	Latin	Greek
Emphasizes natural sciences.	Analytics	*Elective.*
Elective.	Chemistry	English
Latin		No chemistry nor analytic geom.
	Courses are designed for	
	Engineer	Lawyer
	Physician	Pastor
	Philologist	Physician
		Classical Philologist

Scholars finishing at these three may go to the University or Technical High School (Polytechnikum).

that the teacher did practically all the work done at the board or that one pupil at a time worked and explained before the class it became clear to me. The limited amount of blackboard space and the way they are mopped with a wet sponge are matters of curiosity to us foreigners. The cynic might remark that the clearest evidence that some of our teachers have studied at Harvard is that they carry their books in a green bag, or that they have studied in Germany is that they have discarded our dustless erasers in favor of the smeary sponge.

I got the impression from the number of suicides of gymnasium students that were constantly reported in the daily papers that the pressure on the scholars is much severer in Germany than with us. The reasons assigned for the suicides were failure to pass or shame at some disgrace in connection with their school career. The Germans did not think these were unusual in number or due to overwork on the part of the pupils.

The scholars did not seem to me to have the many outside distractions from their school work which are assuming such a grave aspect with us. Athletics are not followed to nearly the extent

by the schools that they are with us, nor are they interscholastic. The field day which I attended and in which my friend mentioned above was a leading participant would have been counted less than of first grade in our city high schools, I believe. The discipline which the teachers maintain outside of school hours also attracts our attention. When I asked how the young people were kept from smoking cigarettes or from going into the "Automats" and getting a glass of beer or even of something stronger by dropping a ten-pfennig piece into the slot, I was assured that the school authorities regulated those things and the pupils could not do them without getting into serious trouble. The school authorities also look after the enforcement of curfew regulations, I believe.

The unimportant role which textbooks play in mathematical training and the facility which the young students have in getting instruction through lectures is rather remarkable to us brought up under a textbook regime. One never heard students talking about or quoting any textbook they had studied in school. Sometimes they would read up a subject independently in some book. In discussing the subject of mathematical schoolbooks in the reports mentioned above Lietzmann says:

1. It is universally admitted that the chief object of the schoolbook is for the pupil to review at home what he has been taught in class.

2. The use of a textbook for the teaching itself is defended by very few.

3. The use of the textbook for the preparation of assigned lessons is scarcely usual any more today.

4. They enable the pupil to make up what he has lost by absence from class.

He quotes Simon as saying that the use of a text in the Quarta of the gymnasium he would consider a crime against the pupils.

Further Lietzmann quotes Reidt, who relates a real case as occurring about this way: In the first period a proposition is gone through with and assigned for home study. The next period all of the pupils are asked to repeat the proposition and the proof verbatim. He who can is given the task of mastering theorem two for the next lesson. The others are made to repeat number one. So it proceeds from day to day. He quotes another monstrosity, as he calls it, wherein the teacher asks, "What is on page 71?" The pupil repeats it and the teacher replies, "That is all there, what is on page 72?" Are such things unheard of on this side of the Atlantic?

Lietzmann thinks that practically all of the teachers follow the inductive method and he says, "There is scarcely a teacher to be found today who does not proceed heuristically; that is, through a continual play of questions and answers he employs the pupils in the acquisition of the new material."

I was impressed with the apparently small amount of assigned work given out to be done in the courses I attended and the lack of responsibility which there seemed to be to do even that little. On the other hand, I was impressed by the ability of the students to do independent and original work and the zest with which they pursued some line of work which attracted them. Their command of what they had learned, the definiteness of their knowledge and their powers of valuing and criticizing a piece of mathematical work were quite noticeable. Lietzmann notes a change of attitude in Germany regarding the necessity of really knowing mathematics. He says: "It was once held that one would not overdraw the matter to say that a pupil might forget all the mathematics he had ever learned without any harm and the value of the study to him would still remain. On the other hand today people do not look askance at the value of geometry. Consequently, as the number of theorems is constantly being reduced to the skeleton of the merely essential, the practical application is pressing into the foreground."

The high social position which the teachers and professors hold and the deference which is shown them not only on the part of the students is noticeable to us Americans. While there seemed to be close enough personal contact between teachers and pupils in the schools the relation seemed to me to be more on the basis of authority than it is with us. The respect paid to those studying at the universities was evident and it made my democratic blood boil when a professor admitted to me one day that a German student dare not do certain kinds of very decent labor for he would be despised by his colleagues. On the other hand some students at the University of Rome complained to me of the low esteem in which students are held today in Rome. I might add here that of all the students I had anything to do with not any impressed me any more favorably for manliness and dignity than three young Egyptians with whom I spent an afternoon and evening in and around Cairo.

As to the professors, one cannot help being impressed by the interest which they all have in intellectual work in their line outside of their regular courses. They seemed to me to be more pleased

than the students, if possible, when a holiday season came around. That set them free for their editorial work or their research. As I looked over the immense number of new mathematics books which were constantly coming into the library for inspection I quite agreed that of making books there is no end in Germany. The number of advanced treatises written by school teachers is almost incredible to us. One needs only to consult Teubner's catalogue to get a notion of this.

Other points which impressed me and which I can only mention are the respect which the teacher or professor has for the dignity of his position, for the value of his work and for the worthiness of the study of mathematics; the laxness in looking after the students' work; the vast difference between the treatment in the schools and in the first year in the universities; the fewness of the written reviews and tests or examinations; the great stress which is placed upon oral examinations, whether for promotion in school, for granting diplomas to engineers or doctors or lawyers, or for granting the degrees. In some of the large engineering classes the professors would be employed for many days in the private oral examinations.

As a good illustration of the patience and persistence with which a German will work I mention a moving-picture exhibition given one night in Munich which I got to attend. There was a distinguished audience present including the Prince, now King Ludwig. The exhibition and lecture was given by School Counselor Münch of Darmstadt on the subject, "On the Use of Moving Light Pictures in Geometry, Astronomy, and Mechanics." He had made thousands of the most accurate drawings and had photographed them to make films and with these he entertained us for more than an hour showing how they could be used to illustrate mathematics, from simple demonstrations of the law of Pythagoras on up to quite complex problems in the subjects mentioned. It was quite striking to see the change in the form of a graph or in the roots of an equation or the various transformations of a family of conics as a parameter varied going on before your eyes. The laity of course were highly enthusiastic. Some of the men at the Technical High School the next morning, however, thought that it was too sensational, *reiner Unsinn*.

The teachers' seminar which I attended happened to be for candidates who were to become modern language teachers. Their maturity, their seriousness, the accuracy of their information about things which we pay no attention to in English, the extreme

pains to which they went in preparing to teach a lesson, the frankness and fulness with which they criticized their own work and each other made a deep impression upon me.

After a teacher has finally passed all of his examinations and his probation periods and has received a state appointment he is assured of a life position with a pension when he wishes to retire. This, of course, has its influence on the equanimity with which a teacher may pursue his work. I had the feeling at times that it had a deadening influence in this way that one never heard of a teacher doing further work at the universities or in summer courses after being safe in his position. My observations may have extended only to those who had already had a training far beyond what is usual with us. My impression is that the gymnasium teachers are as well, if not better, prepared than are the college teachers with us. One should remember in this connection that the Gymnasium belongs to the secondary schools of Germany, their last year of work being about of the same grade as the Freshman year in college with us.

You may now care to hear something of the mathematical autobiographies of a few of the young men with whom I was most closely associated while in Munich. I have spoken of one who had already finished his preparation for mathematics teaching. The next one quoted is a student preparing to become a teacher of mathematics and physics. I considered him quite gifted in mathematics, strong in his intuitions, rather than in his powers of continuous application to work. He will finish up the work for the doctor's degree this year as well as his required work for admission to teaching. Extracts from his letter follow:

"After four years in the Volkschule I began my education by attending a humanistisches Gymnasium. This is a type of our intermediate schools in which youth as a rule between 10 and 19 are found, in case they wish to gain entrance to the higher institutions of learning. * * * * * From my thirteenth year I attended a Realgymnasium and passed my final examinations there, which admitted me to academic studies at the University and the Technical High School. Since then I have studied at these institutions and have passed the two state examinations which are required for a state appointment as teacher. The first examination required knowledge of the fundamental branches, algebra, analysis, analytical geometry, descriptive geometry, etc. The second examination is to test the ability for scientific investigation."

"My colleague will report to you on the pedagogical seminary.

I should like to say in this connection, however, that I do not approve of them as they are usually conducted here at present. We have a whole year of probation teaching to do, and there are always some mathematics teachers present. This is calculated to take away all the joy of the teaching profession."

(To be continued.)

THE HIGH SCHOOL AND CITIZENSHIP.

"High school teachers of social science and history have the best opportunity ever offered to improve the citizenship of the land," says Dr. Thomas Jesse Jones, of the United States Bureau of Education. Dr. Jones believes that the 1,300,000 boys and girls now in American high schools form the largest group of persons anywhere in the world who can be guided into acquiring the "social point of view" by means of the subjects of social science and history taught in the modern way.

"Good citizenship should be the direct aim of the high school courses in social science and history," he declares. "Good citizenship is the test that must be applied to every topic in these courses. Facts, conditions, theories, activities which do not contribute directly to the appreciation of methods of human betterment have no claim on the time of the high school pupil."

Dr. Jones points out that under this test civics must not be merely a study of government machinery, but a study of all manner of social efforts to improve mankind. "Every pupil should know, of course, how the President of the United States is elected; but he should also understand the duties of the health officer in his community. It is the things near at hand and socially fundamental that should be taught first of all. Comparatively few persons have any need of knowledge of Congressional procedure, but every citizen should know what are the chances of employment for the average man."

Proposed topics in this newer high school civics are: Community health, housing and homes, pure food, public recreation, good roads, parcel post and postal savings, community education, poverty and the care of the poor, crime and reform, family income, savings banks and life insurance, human and material resources of the community, human rights versus property rights, impulsive action of mobs and the selfish conservatism of tradition, public utilities, like street-car lines, telephones, and light and water plants.

"The purpose is not to give the pupil an exhaustive knowledge of any of these subjects, but to give him a clue to the significance of these things to himself and to the community, and to make him want to know more about the conditions under which he lives. It is to help him to think civically, and, if possible, to live civically."

SECOND TERM GEOGRAPHY FOR CITY SCHOOLS.

By D. W. Strayer,
York High School, York, Pa.

Geography, for good reasons, is probably offered more commonly as a first year subject in our public high schools than any other science; but today, geography, together with the other science courses, is undergoing a process of reorganization that will make it better and more valuable than ever before. The chairman of the natural science committee of The Commission of the N. E. A. on the Reorganization of Secondary Education, reaches the heart of the matter for science in general in these words, "Certain defects of science courses in content and in methods are becoming increasingly apparent. In some respects science teaching is not as closely related to the environment and experience of the pupil today as it was a quarter century ago."[1] And further on we have this significant statement, "It is obvious that science teaching will profit greatly when the experience of instructors in many high schools becomes common property." The object of this article is to record a promising line of development for second term geography that has been tried out for the last two years with the best of results, and has received the approbation, not only of practical educators, but of business men and manufacturers as well, wherever it has been explained.

The conditions here are unusually favorable for developing courses along new or promising lines in that the community has adopted the system of Coöperative Industrial Education[2] now spreading so rapidly in places where it is practicable. For the benefit of any who are unfamiliar with the workings of such courses, it may be well to state that the aim is to teach the trades or commercial occupations and give the pupils the best of what the high school can offer them in four years at the same time. The pupils in each line of work are divided into two equal groups, one group working in the shops or offices of the city for a week while the other group is in school, then reversing the groups during the succeeding week and alternating thus throughout the course. The pupils of these courses are not, therefore, looking forward primarily to college as in the general courses so that subjects can be developed as seems best without the constantly re-

[1] Bulletin 41, 1913. U. S. Bureau of Education. "The Reorganization of Secondary Education," p. 28.

[2] Explained more completely in Bulletin No. 31, 1913. U. S. Bureau of Education. "Special Features in City School Systems."

straining bugaboo of having to meet the arbitrary and varied requirements of all of the colleges in the country. The pupils do not go into the shops until the second year of the course, so that they are in school without interruption throughout the first year of high school. It is evident that a subject must prove its worth to be put on a schedule when the equivalent of but a half year of school work is available during the last three years. The first year, as originally planned, provided for english, algebra, geometry, shop arithmetic, and technical sketching; but it was found that another subject could be carried. The course outlined in this paper was then developed and has so thoroughly proved its value that the Director of the Coöperative Courses repeatedly asserts that it is one of the strongest subjects in the industrial courses. He was selected for his position and judged by this rigid standard: "Both manufacturers and school directors were strongly of the opinion that the one to be placed in charge of the department should be a mechanic, one fully conversant with shop methods and requirements; that he should have a thorough knowledge of the theoretical side of mechanics, and that he be possessed of the teacher's personality." The fact that a man of this character as well as manufacturers and a representative of the national Bureau of Education commend this modified geography course would seem to indicate that geography, properly developed, ought not to take second place in our general courses to any other first year high school subject, except possibly language work in English.

Today, our geography, like our national life, is broadening. Years ago and until recently, most of our high school geography came either directly or indirectly from the work of our Geological Surveys, or the Coast Survey, or the Weather Bureau; but, important and fundamental as their work is, the development of the great Departments of Commerce, of Agriculture, and of Labor, along lines that are just as essentially geographical, shows that our study of geography must expand also if we are to keep abreast of the times. We are working away from a whole year of purely physical geography toward the wider subject—high school geography. It seems to be the consensus of opinion, however, that physiography serves best for the first term's work, and we made it such in the course in question with the omission of the less important topics.

Some one might suggest, "Why not use, during the second term, any of our commercial geographies or one of the newer works that aim to fill this need for a wider geography course?"

The latter books seem to me not to have gone far enough in the right direction, while the commercial geographies are overloaded with non-essentials and, without exception, deal too much with the agricultural. Anyone can easily satisfy himself of this latter fact by analyzing any of our well known commercial geographies. A cursory examination of the cuts other than maps and diagrams reveals a majority of pictures of wheat fields, or of rice or cotton fields, of irrigation of sugar beets, or of a grove of date palms, etc. Then, if we analyze the book by pages, we get these results for three widely used books, from the beginning to the end of the chapter on the United States, and excluding those chapters on commercial controls and physical characteristics that are largely physical geography:

	Book No. 1.	Book No. 2.	Book No. 3.
Raw products and agriculture	58 pages	78 pages	106 pages
Manufactured products	11 pages	9 pages	13 pages
Transportation	14 pages	13 pages	16 pages

Notwithstanding such a consideration of subject matter, one of these books informs us that

41% of our population is engaged in manufactures and commerce;
36% of our population is engaged in agriculture.

This being the case, it is evident that we are not keeping up with our industrial development in our study of geography. From a consideration of the above figures, and from our needs in the schools of our cities, I heartily agree with Prof. R. H. Whitbeck in his statement in SCHOOL SCIENCE AND MATHEMATICS[3] that our book firms should provide us with two types of high school geography books, the one for cities tending toward manufacture and commerce, the other for rural communities dealing with the natural and agricultural aspect of the subject, neither type to neglect entirely, however, a consideration of the other side of the subject. The courses for cities must take cognizance of the environment of city pupils to get the best results for the community and for the nation as a whole in its efforts to expand industrially. Our foreign commerce must change from one consisting mainly of raw materials and slightly manufactured articles to the more profitable manufacture of complex products, for raw materials are becoming more valuable every year so that we are draining our resources by sending them abroad. Education is the key to the situation; and we must recognize this, as the Germans

[3] School Science and Mathematics. May, 1912, p. 396.

have done, and plan our science and other courses accordingly. The following outline covers essentially our second term's work, and is given here as an expression of the needs of an average industrial city of today—York being a town of about 50,000 inhabitants and the thirteenth city in Pennsylvania in the value of manufactured products.

1. The Relation of the Individual to Industry.
2. Milestones in the Industrial Evolution of the World.

Industrial Controls.

3. Industry is Dependent upon Natural Conditions.
4. Human Control is an important Factor in Industry.

The World's Work.

5. The Occupations of Mankind.
6. The Principal Industrial Raw Materials.
7. Some Important Manufactures of Today.
8. Transportation.

The United States.

9. Brief Study of Our Industrial Development.
10. The Industrial Position of the United States.
11. Our leading Industries.
12. Physical characteristics.
13. The New England States.
14. The Central States.
15. The Southern States.
16. The Middle West.
17. The Western States.
18. American Colonies and American Industry.

Foreign Countries.

19. Canada, Mexico and the West Indies in Relation to American Industries.
20. South and Central America in Relation to American Industries.
21. Europe in Relation to American Industries.
22. Asia in Relation to American Industries.

State and City.

23. The Industrial Development of Pennsylvania.
24. The Physical Characteristics of Pennsylvania.
25. The Principal Industries of Pennsylvania.
26. Transportation in Pennsylvania.
27. The Influences which laid the Foundations for local City Industries.

A discussion of the reasons for incorporating each topic in our work would go far beyond the limits of a magazine article, so that I shall not attempt it. Until some progressive book firm issues a geography suitable for the needs of city high schools, a statement of available material is more to the point.

The better class of commercial geographies must serve in a way, until something better is available, for all topics except Nos. 1, 5, 7, and 23 to 27 inclusive. These topics are not adequately treated in any school geography at the present time. I know of

no briefer or better statement of how No. 1 should be developed than that included in a single paragraph of an article by W. J. Sutherland in the February, 1914, number of SCHOOL SCIENCE AND MATHEMATICS, p. 147, and the reader is referred to that paragraph and also to the one on p. 148 of the same issue.

Topics 5 and 7 require a fuller statement than any of the others; and here again, the following clause from another sentence in the same article covers the need for emphasizing these topics: "vocation or industry is the link which ties man to his environment." Any teacher who has really learned to know his fourteen year old freshmen knows how totally innocent they are of any definite knowledge of the commonest and most necessary information concerning vocations and of the production of the clothing they wear, of the food they eat, and of the commonest materials of construction. That this is so is one of the most pertinent criticisms of our schools met with in popular literature; and we teachers, as a profession, are not working up to our ideals of public service if we hedge by saying that such work has hitherto not been considered in the text-books of our particular science subject. First year students have had no science before they reach us, and we ought to be willing to throw aside some of our subject matter that is of questionable value to substitute as much as we can of that which they must know to make the most out of their lives after the few years that we have them under our direction. It should not be a question of where such work shall go in, but rather a matter of getting it done because it is so necessary.

With reference to topic No. 5, we devote from ten to fifteen recitation periods to a survey of the pupil's choice of some fifty occupations. This seemingly great task is accomplished in eight exercises assigned at intervals of two or three days and extending over about one school month, intervening periods being taken up by recitation work on preceding topics. Each pupil selects one occupation in writing up each of the following exercises:

1. Choice of Occupations open to a Boy (Dictated by teacher).
2. The Machinist Trade; or, The Occupation You Intend to Follow.
3. Moulder; Bricklayer; Tailor; Telegrapher; Plumber.
4. Electrician; Carpenter; Baker; Stone Cutter; Bookbinder; Typesetter; Printer.
5. Weaver; Loom-fixer; Blacksmith; Draftsman; Steamfitter; Sign-painter; Pattern-maker.
6. Stationary Engineer; Sheet Metal Worker; Clothing Manufacturer; Photographer; Jeweler; Railroading; Confectionery Manufacturer.
7. Stenographer; Bookkeeper; Advertising Manager; Salesman; Business Manager; Traveling Salesman; Banking; Real Estate; Civil Service.
8. Any profession, or one of the artistic or literary vocations.

The pupils interview some acquaintance, let us say a machinist, and write up an article as if for a newspaper, according to the following outline for the trades:

1. Pay, positions and opportunities.
2. Conditions required for learning the trade.
3. Educational, or physical, or other requirements.
4. What those in the trade think of its future.
5. Some local establishments employing men of this occupation.

The articles are then read in class and a general discussion follows, in which salient points are emphasized and additional information is brought out. The information and advice that pupils get for their articles is uniformly excellent and many of them compare favorably with the booklets on vocations issued by the vocational guidance departments of the schools of our larger cities. The Supervisor of the industrial courses speaks of this work in his report in this way: "A noticeable fact relative to the condition of the classes at the end of the second year compared with that of the first year is that all of the boys who start in the industrial course do not continue it. Every effort is made in the first year of school work to get the boys acquainted with the advantageous and disadvantageous features of all the trades. The boy is encouraged to make a study of all the trades in the endeavor to help him find himself. It is a fact true to nature that all boys are not inclined instinctively to perform shop work, and the sooner a boy discovers his likes and dislikes, the sooner he discovers what work is best suited to his nature, the better he can then place himself in a position to take up a line of work to develop his individual inclinations. Many boys change from the industrial course to other courses and many change from other courses to the industrial." Teachers interested in this line of work can secure valuable information by writing to the national Department of Commerce at Washington for Special Report on Vocational Guidance (part of 25th annual report of the Commissioner of Labor.)

For topic No. 7 in the outline—some important manufactures of today—material can be obtained in part in different commercial geographies or better yet in school reference works or in books from public libraries. Ten exercises are devoted to this work, the class work being conducted in much the same way as in our study of vocations. Teachers in different communities would probably choose different topics—the ones selected as most suitable here being:

1. The Manufacture of Cloth; or the Manufacture of Hosiery and Underwear.
2. The Manufacture of Leather and How it is worked up; or the Manufacture of Carpets or Curtains.
3. The Manufacture of Paper and Books, or Tobacco Raising and Cigar Manufacture. (A large local industry.)
4. The Manufacture of Furniture or Pianos, or the Manufacture of Varnish and Paint.
5. The Manufacture of Artificial Ice. (Local industry.) The Manufacture of Automobiles and Automobile Development. (Local industry.)
6. The Different Mineral Fuels, and Their Use in the Industries of Today.

Structural Materials.

7. The Quarrying of Stone and the Manufacture of Cement.
8. The Extraction of Copper from its Ores and the Composition of Alloys of Copper.
9. The Manufacture of Pig Iron from Iron Ores and Its Use in the Foundry.
10. The Processes by which Pig Iron is changed into Steel.

Topics 19 to 22 in the general outline are self-explanatory. It seems that any teacher would take exception to a catalogue-like statement of irrelevant information about all the countries of the world as given in many geographies. All that we need is subject matter that reveals the relation of remote foreign countries to the commerce and industries of our own country.

Topics 23 to 26 are best treated at present by a study of the last Bulletin on Manufactures issued by the Bureau of the Census for each state and obtainable by writing to the Director of the Census or to congressmen. This, together with any reference books that may be available, must serve until we can induce our State Geological Surveys or Departments of Education to provide us with so valuable a bulletin as that issued recently by the Wisconsin Survey. I refer to "The Geography and Industries of Wisconsin" by Prof. R. H. Whitbeck, which is published for the schools and is furnished them for the mere price of mailing.

Topic 27, a study of the reasons for local industries, is an intensely interesting subject and serves as a fitting close to the year's work; for, when practicable, pupils bring in raw materials, show products in process, and take great interest in studying out the causes for the development of the particular industry they have selected in this particular locality. In conclusion, the writer desires to emphasize two points, (1) that this outline is merely the expression of what has been found useful in one typical industrial community located in the midst of an agricultural district; and, (2) that we need separate texts in geography for city schools and they must come before the best results can be obtained.

THE TEACHING OF SCIENCE BELOW THE HIGH SCHOOL.

By S. E. Coleman, Percy E. Rowell, George C. Barton.

[A committee report presented and unanimously adopted at the summer meeting of the Pacific Coast Association of Chemistry and Physics Teachers, June 30, 1914, Berkeley, California.]

At the winter meeting of this association a committee was appointed to report upon the teaching of science below the high school. This Committee on General Science, as it was named, has assumed as its task the formulation of definite and rather fundamental propositions relative to science instruction below the tenth year. No attempt has been made to outline specifically a general science course. Such an attempt presupposes that certain fundamental propositions have already been agreed upon. The committee does not feel that there is, or has been, any such agreement among the teaching body of the country, and believes that until such a basis has been found, for ourselves at least, it would be futile to discuss details of the proposed course.

For convenience of treatment, the report has been put in the form of a set of resolutions that may be heard as a whole, and then, if desired, discussed seriatim or disposed of in whatever manner this association may deem fit. To some it may seem that the report is notable for the numerous questions which it makes no attempt to answer. While this is perhaps true, it has been sufficiently explained in stating our point of view; and we have included only those propositions upon which we (the committee) were able to agree. Some of these are not altogether satisfactory to all of us in their present form; but they express, as a whole, general conclusions which may well be the basis for discussion here.

Our organization should make definite recommendations to the Bay Section of the California Teachers' Association relative to desirable changes in the teaching of science in the public schools of the state. It ought, as a body, to have convictions on matters within its field, and should take proper measures to make them effective. If the science teachers of the state do not initiate movements for the betterment of their own work and the conditions under which it is done, can they reasonably complain if both the work and the conditions remain unsatisfactory?

Surely we can not admit that we are satisfied with either. A large percentage of our children leave the public schools without having had the slightest training in the study of common objects and phenomena of nature. We recognize that the child must be prepared for *social* relations in a multitude of ways. He must be able to communicate with his fellows by spoken and written language. He must have some comprehension of his place in organized society and of the limitations and obligations that it will impose upon him. We now believe that he should be aided by the school in gaining a suitable means of livelihood; that he should begin to understand the conditions that make for personal and public health. In a score of ways we try to prepare him for relationship with the home, with the local community, with the state and the nation. This is all well and good. He will live among his fellowmen, and must be so trained that he will not be a menace to them, and that he may make the most of himself individually and for society. In short, we try to fit him for his social environment.

But what about his relations to earth and air and sky, to the myriad forms of animal and plant life that are all about him? Does he look at them and see them not? Is the great world of nature but a featureless

background upon which are thrown the changing pictures of human life? Will he utilize, through all his days, the things that nature provides for him, with never a thought for the wonderful processes that have made the things he appropriates? Must he remain unconscious of the order and system that underlie these processes? Shall we give him no introduction to those characteristic methods of observation and induction that have revealed law and orderly sequence in the seemingly inconsequent phenomena of nature? Shall we let him lose the real joy that is the heritage of every sympathetic student of nature? Surely these things can bring as much into his life as the best that we are giving him in other lines.

The committee, therefore, reports for your consideration the following resolutions:

RESOLVED:

1. That the beginnings of education in science should be made in the grades below the high school.

2. That, under favorable conditions, occasional lessons from nature rather than from books (so-called Nature Study) may with advantage be given a place in all grades from the beginning through the fifth or sixth, and followed in the later grades, through the eighth or ninth, by the more systematic work which may be termed General Science.

3. That, as local conditions permit, provision should be made for a unified, purposeful series of lessons in the beginnings of science, through the 6th, 7th and 8th years, the 7th and 8th years, or the 7th, 8th and 9th years, according as the organization of the schools or other local conditions may determine.

4. That these science lessons should be prescribed for all pupils, for the following reasons:

a. The very large percentage of pupils who do not go beyond these grades should not miss the opportunity for this minimum instruction in science.

b. Science rightly taught provides a means and a method in education which are essentially different from those of the other subjects, and which are of the highest value in the development of the child mind.

c. Such courses provide something of a significant insight into the nature of science in general, and of various sciences in particular, and also into the relation of the sciences to modern life; all of which may and often will help the pupil in his choice of further education and in his choice of life work.

d. The recognition of the relation of the sciences to life will tend to hold the pupil in school longer.

e. The science lessons provide tangible objective material which is highly serviceable as a basis for language lessons, both oral and written.

f. The specific facts learned from the science lessons are as valuable for the needs of daily life as are those learned from the study of the other subjects pursued in these grades.

5. That the science material for this general introductory course should be drawn from all the elementary sciences; from the biological sciences, with emphasis on physiology and hygiene, and from the physical sciences, with reference particularly to the chemical and physical properties and processes comprehended in the elementary study of natural phenomena.

6. That in rural schools the illustrative material for the course may profitably be drawn, to a large extent, from the field of agriculture.

7. That simple and inexpensive apparatus suffices and is recommended for much the greater part of the science instruction of these grades. Articles found in the home will, to a large extent, serve for the repetition of experiments.

8. That new school buildings should be planned with special rooms for the science of the 7th, 8th and 9th grades. These should be of larger size than the ordinary class room, to accommodate an experimental table, with gas and water plumbing, tables for growing plants, an aquarium, etc., together with storage accommodations, preferably in an adjacent room.

9. That the information and training afforded by the science lessons, as here proposed, would and should serve as a substantial and valuable preparation for any and all of the science courses of the high school, making progress in the same less difficult and reducing the number of failures.

10. That, with the exception of general science, and of physical geography in part, the subject matter, scope and method of the high school sciences would in no wise be affected by the introduction of science into the grades below.

11. That nature study or general science in the grades must of necessity be of little value unless it is in the hands of teachers well qualified for the work, and is made primarily and predominantly an objective study of things and phenomena at first hand, with the use of books in a subordinate role.

12. That a broad knowledge of science in its elementary branches, and the kind of training that such knowledge implies, are highly important to the grade teacher as a part of her general preparation for her work; and that, having such knowledge and training, she will find abundant opportunity to make effective use of it in any and all grades.

It is therefore recommended:

a. That prospective teachers be advised to take as many of the sciences as possible in their high-school course.

b. That the normal schools of the state offer not less than a one year course in physical science, comprehending and correlating the most generally significant elements of chemistry, physics, physical geography and astronomy, with instruction in the utility of such material in the primary and grammar grades; and also not less than a one year course in biological science, representing the same point of view, and dealing primarily with plant life, human physiology, hygiene, and sanitation.

The names of the various specialized sciences are here used merely for convenience in designating the source and general character of the subject matter, and not as implying that any of this material should be classified or organized as it is in the separate sciences. On the contrary, a new and effective correlation of these diverse elements of the sciences would greatly enhance the value of the course.

A METHOD OF PRESENTING A LESSON SERIES IN EXPERIMENTAL COOKING.

By Grace Gordon Hood,

Head of Domestic Science Department, Lewis Institute.

The type of experimental cooking of value to the high school pupil will vary with the locality, the kind of school, the types of pupils, and the nature of their previous training. It is the aim of this article to show a possible method of presenting an experimental series with some obvious practical applications, to a class in a general high school course with little or no pure science as a background.

Baking powders are often a perplexing problem to the housewife; she feels sure that if one brand is much more expensive than the rest it must be "better," but "why?" To fully cover the problem adequately for the high school pupil would require about three lessons; one discussion of one hour's duration, or a forty-five minute period, and two laboratory periods of one hour and a half each.

Method of Approach.

The lecture-discussion would come first in the series.

I. Leading from the question of, "What makes biscuits light?" the subject of baking powders is introduced.

II. How do they make biscuits light? By a series of demonstration experiments the teacher can show the following things:

(a) Baking powder of all kinds produces gas when moistened.

(b) Different kinds of baking powders produce slightly different amounts of gas at the same temperature.

(c) Different kinds of baking powders produce the maximum amount of gas at different rates of speed.

(d) All baking powders act more rapidly when warmed in solution.

A discussion of the composition of the powders, and why the gas is formed might be followed with a brief summary of the residues left in the bread and their probable harmlessness when taken in small quantities. Assigned reading might be given in Olsen's *Pure Foods,* Chap. 16; Synder's *Human Foods,* Chap. 12; or some other book within the understanding of the pupils.

Lesson II.

This and the following lesson would have as an aim to determine, (1) the best method of handling various kinds of baking powders to produce the best results in every case; (2) whether

or not a recipe must be changed when different kinds of baking powder are used; (3) what proportion of each kind of powder will be sufficient to use with one cup of flour when baking powder is the chief means of providing a leavening agent; (4) does any kind of baking powder leave an unpleasant appearance or taste; (5) what kinds of baking powder are most satisfactory for household use in relation to initial cost and the results of the above determinations.

Method: Use a standard baking powder biscuit recipe, using the same quantity of each ingredient in each part of the experiment, as well as the same kind of flour, fat, etc., changing only the kind of baking powder. The baking powders may be selected from those available in the local markets, such as "Royal" as a cream of tartar powder, "Hotel" as an alum powder, etc.

Experiment I. Prepare baking powder biscuits, using various kinds of powder in the same proportion in each case; make several mixtures. Cut in uniform shape and size, and bake samples of each mixture at the following temperatures: 175° C., 180° C., 190° C., 200° C., 210° C., 220° C., and 230° C. Compare the finished products as to texture of crust and crumb, and increase in bulk. Does the same temperature produce the "best" biscuits with each kind of powder? Why?

This experiment presupposes that several ovens into which thermometers may be fitted are available.

The experiment would best be conducted as a class problem, the final results being determined as a summary of the lesson.

After a brief review of the previous lesson, the experiment and the problem involved would be presented by the teacher, and the work divided among the pupils. The biscuits would then be prepared using a uniform method of mixing, and the same sized cutter and the same method of packing in the pans (preferably packed close together) in every case. While the biscuits are baking, those not in charge of the ovens could wash the dishes and care for the laboratory; and when all the samples, carefully labeled, are done, they could be placed together on one table and examined by the class as a group.

First: Compare all of the cream of tartar products to see which temperature produced the "best" result, and similarly with each kind of powder.

Second: Compare all the samples baked at 175°, etc., to see which produced the best result at each temperature.

Third: Conclude which baking temperature produces the best result with each kind of powder.

To divide the laboratory work among the members of a class of fourteen:

Kind of Baking Powder.	Temp'ture for Baking.	Assigned to Pupil No.
Cream of Tartar	175°C.	Two
Cream of Tartar	180°C.	Four
Cream of Tartar	190°C.	Eight
Cream of Tartar	200°C.	Ten
Cream of Tartar	210°C.	Nine
Cream of Tartar	220°C.	One
Cream of Tartar	230°C.	Seven
Phosphate	175°C.	Two
Phosphate	180°C.	Ten
Phosphate	190°C.	Eleven
Phosphate	200°C.	Thirteen
Phosphate	210°C.	Twelve
Phosphate	220°C.	Five
Phosphate	230°C.	Fourteen
Alum	175°C.	Four
Alum	180°C.	Eight
Alum	190°C.	Eleven
Alum	200°C.	Thirteen
Alum	210°C.	Six
Alum	220°C.	Seven
Alum	230°C.	Three

NOTE: Trade names such as "Royal" might be used above.

In a real class the assignments would best be by name. Note that there are seven students who have been assigned two mixtures each, while the other seven have but one, which will give them time to attend to the ovens for the entire class.

Oven Assignments.

Temperature.	Student.
175°C.	One
180°C.	Three
190°C.	Five
200°C.	Six
210°C.	Nine
220°C.	Twelve
230°C.	Fourteen

LESSON III.

This lesson would begin with a summary of the previous les-

son, followed by the presentation of the new experiment and the division of the work.

Experiment II. Prepare baking powder biscuit with various kinds of baking powder using 1 teaspoonful, 1¼ teaspoonsful, 1½ teaspoonsful, 1¾ teaspoonsful, 2 teaspoonsful, and 2½ teaspoonsful, respectively, of each per cup of flour. Bake in uniform shape and size, at the "best" temperature for each kind of baking powder. What proportion of each kind of powder produces the best results in appearance, flavor and texture?

The division of work might be similar to that in the previous lesson.

Compare and summarize results. The above lessons could be profitably followed by a technical lesson wherein the biscuit mixture is prepared by each student under the most favorable conditions for a perfect product, using the mixture to produce various products by making slight variations in shape, fat and flavoring materials, etc., thus producing shortcake, pinwheel biscuit, apple dumplings, and other dishes.

Where thermometers are not available, and the laboratory equipment is limited as to oven space, the following variations are suggested.

First: Instead of using definite temperatures, such as 175°C., the experiments might be carried on by baking the products in a "slow" oven, "medium" oven, "hot," and "very hot," making the test with browned papers or by feeling with the hand. In any case, the students will readily observe that uniform temperature throughout the baking process is not advisable, as it results in pale, dry products at a low temperature, and dark, hard products at a high temperature. They observe that the cream of tartar powders require a "hot" oven to produce the most desirable product and that the phosphate and alum powders require a "slow" oven or a low temperature (175°-180°C.) until the product is light, then a higher temperature to form the crust and to brown. The gas in case of the last two seems to form more quickly than when a cream of tartar powder is used; and at a low temperature, the formation of gas takes place more slowly, forming a crumb of fine even texture rather than large gas holes and a broken crust which is hard and tough when a hot oven is used throughout the process of baking.

Second: If only one or two ovens are available it would be necessary to bake two or three times. All samples to be baked at a "low" temperature are baked at once, and those for the

next stage baked next in order, gradually increasing the temperature of the ovens for each successive stage.

Experiment two is always interesting, as the students find that it is not necessary to increase the amount of baking powder for a cheap powder, such as "K. C.," over the amount of an expensive powder, such as "Royal," if each is properly baked; and also that such an increase in amount leaves an unpleasant taste and large gas holes full of air, not food material. They are also surprised to find that a very good product, of even, tender texture can be produced with less baking powder than most recipes state.

TESTING MARKET VALUES IN COFFEE.

By Georgia Finley,

University of Indiana.

A test which could be carried out in high school or college with interesting results, was performed in the kitchen laboratory of Lewis Institute, Chicago, with different grades of "blended" and "straight" coffees, bought on the market as the ordinary homemaker would buy for her own consumption. The purpose of the experiment was to ascertain whether the extra price paid for the so-called better grades of coffee, justified the difference in expense from the housekeeper's standpoint of color, strength, and flavor.

Eleven samples ($\frac{1}{4}$ lb. each) were bought from retail stores; they were a fair representation of the different grades of coffee then on the market in that locality. Each sample was labeled by the merchants when purchased, consequently no mistake could be made as to brand or price. The coffee was ground to a fine powder, pulverized in a hand mill. Each sample was tested in cold water before grinding to determine whether the coffee contained an adulterant. The brands were numbered, thus concealing the brand and price from the testers. Two level tablespoons were put into a closely woven muslin cloth stretched over an ordinary coffee cup and 1 cup of boiling water was allowed to drip through once. The cups were numbered to correspond with the numbers of the brands. As soon as the water had percolated through, the extractions were tested for color, strength, and flavor. As the testers were ignorant of the grade of coffee in the various cups, they were entirely dependent upon their individual taste for the decisions. The color was designated as dark,

medium, or light; the strength as strong, mild or weak; the flavor, as agreeable or disagreeable, with specification as to whether it was *aromatic, bitter,* a distinct blending of recognized flavors or undetermined. (One might, of course, add many other descriptive adjectives, as, *raw, over-caramelized, metallic, insipid,* etc.)

The results seemed to justify the conclusion that the "choicest Santos, straight" of one dealer, at 25 cents, proved as acceptable to the majority of the seven testers, as did the "choicest Santos, blended with Bogota, and Mandheling Java," at 40 cents, of another dealer; and similarly with some of the other samples. Only one of the testers considered the flavor of the vacuum coffee as equal to that of the other samples; yet this is a vacuum-roasted coffee at 50 cents, prepared by a special process known as the steel-cut process, in which the chaff is blown out of the coffee and a part of the caffein is claimed to have been removed. It was the highest priced coffee then on the market in that locality; but judging from flavor, would not seem to justify the price paid for the special process of manufacture.

THE BED, ITS EQUIPMENT AND CARE.[1]

By Minna C. Denton,

Ohio State University.

(This series is offered as a contribution of material suitable for courses in House Decoration and Furnishing, Home Nursing, Household Management, Home Sanitation, or Housewifery. Lack of school equipment need not prove an insurmountable obstacle; it is usually possible to borrow for the occasion, from private homes or from shops, most of the material needed.)

V. Springs. Box, woven wire (single or double), link, ribbon and spiral, etc.; reinforcements—interwoven at various intervals, supporting spirals, lateral frame, etc. Compare as to comfort of sleeper; ease of handling, moving and cleaning; durability, liability to sag, cost. Consider various substitutes for springs (rope-net, canvas) if desirable to do so. Consider expedient of placing heavy ticking or soft paper over springs, to catch lint from mattress, and to save wear on it.

Note: "Sag" in springs and mattress is a matter not only of comfort but also of hygiene. Sagging materials give way most

[1]The first four topics in this series were outlined in October School Science and Mathematics. Continuation in future numbers.

markedly under heaviest part of body; this results in straining of back and side muscles, and undue pressure on pelvic organs because other abdominal contents rest more or less upon them—a pressure which should be relieved during sleeping hours. This factor may, for example, promote undue irritability of bladder, especially in children.

VI. Mattress and pillows. Procure samples of different grades of cotton, felt, feathers, hair, and covering fabrics, from department stores or from manufacturers; compare quality and prices. If desirable, consider also local substitutes such as straw, corn husks.

Discussion for each material, as to comfort of sleeper (preference for firm or soft bed, as case may be); cost; wearing qualities; liability to absorb moisture; tendency to retain body heat; liability to pack, shift, or sag; weight and ease of handling; dust-catching surfaces and construction, ease of care, cleaning, and renovation

Consider special devices and constructions; e. g., spiral springs enclosed within mattress, "no-tuft" (separate compartment) construction, mattress divided horizontally into detached sections for ease in handling, etc.

Pillows. Size; note undesirability of many or large pillows, because of placing head, neck, and shoulders in unfavorable positions, thus possibly affecting development of normal proportions in upper spinal curves and conducing to faulty carriage of figure (especially important in children), or possibly promoting tendency to double chin, sagging of flesh, wrinkles, in older persons.

Note Japanese usage of hard pillow, bolster or block placed under neck instead of under head.

Tendency of feather pillow to heat head and to absorb moisture; desirability of hair pillow for fever patients in some cases.

Bolster; does it have real usefulness, in modern households?

VII. Mattress pad or cover. Necessity for protection of mattress from staining, from body perspiration; protection less difficult and expensive than renovation. Nature of protection afforded by smooth, quilted pad of non-absorbent, washable material heavy enough not to rumple. Delegation of this function, in cases of sickness where additional protection may be advisable, to extra draw-sheet of rubber, stork cloth, rubber cloth, oiled silk, or even oilcloth or paper.

Nature of protection afforded (from dust and ordinary soilage) by light washable slip covering mattress completely.

Cost, possible home manufacture, for each of above articles.

VIII. Sheets, pillow slips. Materials; merits of various cotton and linen textiles; influence of climate as determining desirable or undesirable qualities of linen sheets; behavior of each fabric in laundering; cost.

Size; should be long enough to "tuck under" mattress at least 12 inches at both head and foot; excessive width undesirable, as covers when hanging should escape floor by at least 8 inches.

Home manufacture of sheet from cloth. Kinds of seams and stitches called for. Use of wide hem (say 2 inches) at one end, narrow (say 1 inch) at other end; reason for this. Compare cost of home-made and of shop-manufactured articles of same grade; of same cost. How many cents per hour does the housewife get for her work in making sheets and pillow cases?

Use of cotton draw-sheet for protection of sick-room bed; protects under-sheet where usually most needed, more easily changed than under-sheet, sometimes a great labor-saver. Manufacture of special narrow draw-sheet from old sheets, or folding of partly used upper or under sheet to make draw sheet.

Pillow slips. Size, materials, method of making, cost, as above.

Legitimate and organic (structural) use of ornamental stitches, in making of sheets and pillow cases; "pillow-shams" considered from standpoint of esthetics.

SOME COMMON ERRORS HEARD IN HOME ECONOMICS CLASS ROOMS.

2. "These foods yield *heat and energy* to the body."

Those of us who attended the University of Chicago conference last spring, will remember that Miss Ruth Wheeler of the University of Illinois then registered her objections to this phrase. "But what is wrong with it?" asked some one shortly afterwards.

Heat is a form of energy, is it not? It is as if one should say, "Cows and quadrupeds." Presumably what is meant is "heat and other forms of energy," or possibly, "heat and muscular energy."

PROBLEM DEPARTMENT.

By I. L. Winckler,
Central High School, Cleveland, Ohio.

Readers of this magazine are invited to propose problems and send solutions of problems in which they are interested. Problems and solutions will be credited to their authors. Address all communications to I. L. Winckler, 32 Wymore Ave., E. Cleveland, Ohio.

Algebra.

391. *Proposed by Letitia R. Odell, Denver, Colorado.*

Show that $1^3+2^3+3^3+ \ . \ . \ . \ +n^3 = (1+2+3+ \ . \ . \ . \ +n)^2$.

I. *Solution by Norman Anning, Chilliwack, B. C.*

Let $S_n = 1+2+3+ \ . \ . \ . \ +n$.

$S_{n-1} = (n-1)+(n-2)+(n-3)+ \ . \ . \ . \ +1$.

$\therefore \ S_n+S_{n-1} = n\times n = n^2$.

and $S_n-S_{n-1} = n$.

$\therefore \ S^2_n-S^2_{n-1} = n^3$.

$S^2_{n-1}-S^2_{n-2} = (n-1)^3$.

$S^2_{n-2}-S^2_{n-3} = (n-2)^3$.

. . . . . .

$S^2_2-S^2_1 = 2^3$.

$S^2_1 = 1^3$.

$\therefore \ S^2_n = 1^3+2^3+3^3+ \ . \ . \ . \ +n^3$.

II. *Solution by P. K. Shah and C. M. Jhaveri, Sojitra, Baroda, India.*

$1^3 = 1^2$.

$2^3 = 2^2+2(1\cdot 2)$.

$3^3 = 3^2+2(1\cdot 3+2\cdot 3)$.

$4^3 = 4^2+2(1\cdot 4+2\cdot 4+3\cdot 4)$.

. . . . . .

$n^3 = n^2+2[1\cdot n+2n+ \ . \ . \ . \ +(n-1)n]$.

Adding

$1^3+2^3+3^3+ \ . \ . \ . \ +n^3 = 1^2+2^2+3^2+ \ . \ . \ . \ n^2+2[(1\cdot 2+1\cdot 3+ \ . \ . \ . \ +1\cdot n)+(2\cdot 3+2\cdot 4+ \ . \ . \ . \ 2\cdot n)+(3\cdot 4+3\cdot 5+ \ . \ . \ . \ 3\cdot n)+ \ . \ . \ .$ to nC_2 terms] $= (1+2+3+ \ . \ . \ . \ +n)^2$.

III. *Solution by T. M. Blakslee, Ames, Iowa.*

As it holds for $n = 1, 2, 3,$ to prove, if it holds for $n = m-1$, it holds for $n = m$.

Let $1+2+3+ \ . \ . \ . \ +(m-1) = S$, (1)

and suppose $1^3+2^3+3^3+ \ . \ . \ . \ +(m-1)^3 = S^2$.

Then $(S+m)^2 = S^2+2mS+m^2$. (2)

Now $S = \frac{1}{2}(m-1)m$, from (1).

$\therefore$ from (2), $(S+m)^2 = S^3+m^3$. (3)

Replacing in (3) the values of S and S^2

$$(1+2+3+ \ . \ . \ . \ +m)^2 = 1^3+2^3+3^3+ \ . \ . \ . \ m^3.$$

IV. *Solution by Katherine S. Arnold, Milwaukee, Wisconsin.*

By the method of differences

$$S_n = na_1+\frac{n(n-1)}{\lfloor 2}D_1+\frac{n(n-1)(n-2)}{\lfloor 3}D_2+ \ . \ . \ .$$

For the left hand side, $a_1 = 1$, $D_1 = 7$, $D_2 = 12$, $D_3 = 6$, $D_4 = 0$.

$$\therefore\ S_n = \frac{n^2}{4}(n+1)^2.$$

For the right hand side, $a_1 = 1$, $D_1 = 1$, $D_2 = 0$, where

$$S'_n = 1+2+3+\ \ldots\ +n.$$

$$\therefore\ S'_n = \frac{n(n-1)}{2}.$$

$$\therefore\ S_n = (S'_n)^2.$$

392. *Proposed by E. L. Brown, Denver, Colorado.*

Prove that the problem of "the duplication of the cube" is the same as that of "finding two mean proportionals."

Solution by Walter C. Eells, Annapolis, Maryland.

Credit for the first solution of this problem probably belongs to the celebrated Greek mathematician, Hippocrates of Chios.

His solution expressed in modern notation is as follows:

If a be an edge of the given cube of volume a^3 we seek the edge x of a second cube of volume $2a^3$.

Let x and y be two mean proportionals between a and $2a$.

Then $a : x = x : y = y : 2a$.

$\therefore x^2 = ay,\quad x^4 = a^2y^2,\quad y^2 = 2ax$ and $x^4 = 2a^3x$ or $x^3 = 2a^3$.

But Hippocrates failed to give a construction for finding x and y. Indeed it is now well known that the prob'em is impossible by methods of elementary geometry, i. e., with ruler and compass. It can be solved very easily by means of the intersection of the two parabolas $x^2 = ay$ and $y^2 = 2ax$, which intersect in a point whose abscissa is the edge of the second cube. It may also be solved by the intersection of a certain parabola and a rectangular hyperbola; also by various higher plane curves, e. g., the Cissoid of Diocles, or the Conchoid of Nicomedes.

Geometry.

393. *Proposed by W. M. Gaylor, Sag Harbor, N. Y.*

If upon the sides of any right triangle equilateral triangles be constructed, the lines joining the centers of these triangles form an equilateral triangle.

Solution by Elmer Schuyler, Brooklyn, N. Y., and G. I. Hopkins, Manchester, N. H.

Let the triangle be denoted by ABC and the equilateral triangles by AB'C, A'BC, ABC'. Circumscribe circles about the equilateral triangles. These circ'es intersect in a common point P. Denote the centers of the triangles and the circles by O_1, O_2, O_3 in the triangles AB'C, ABC', A'BC, respectively.

The line of centers O_1O_2, O_2O_3, O_3O_1 bisect arcs AP, BP, CP, respectively. Hence $\angle O_2O_1O_3$, $\angle O_1O_2O_3$, $\angle O_3O_2O_1$ being measured, respectively, by one-half arcs APC, BPC, APB, are equal to 60° each. $\therefore$ $\Delta O_1O_2O_3$ is equiangular and $\therefore$ equilateral. It is not necessary that ABC be a right triangle.

394. *Proposed by Daniel Kreth, Wellman, Iowa.*

Given, the perpendicular, median, angle-bisector from the same vertex of a plane triangle, to construct the triangle and find a formula for its area.

I. *Solution by Norman Anning, Chilliwack, B. C.*

Construct the ΔOPM right-angled at P and having $OP = p$ and $OM = m$. Describe a circle with O as a center and b as a radius and of the points where it cuts PM let B be that nearer to M. Draw $OD \perp OB$ to cut

PM at D. Then $p^2 = PD \cdot PB$. Let MT be the tangent from M to the circle OBD and on PM find points X and Y such that $XM = MY = MT$. Then OXY is the required triangle.

Let $MT = x$.

Since $\overline{MT}^2 = MB \cdot MD = (PM-PB)(PM+PD)$.

$$x^2 = (\sqrt{m^2-p^2}-\sqrt{b^2-p^2})\left(\sqrt{m^2-p^2}+\frac{p^2}{\sqrt{b^2-p^2}}\right)$$

And area $OXY = px$ since $XY = 2MX = 2x$.

To prove that OB and OD are the internal and external bisectors of $\angle XOY$ it is necessary and sufficient to show that $\frac{XB}{BY} = \frac{XD}{DY}$.

This is true if $\frac{x-MB}{x+MB} = \frac{MD-x}{MD+x}$,

if $\frac{x}{x+MB} = \frac{MD}{MD+x}$,

if $x \cdot MD+x^2 = x \cdot MD+MD \cdot MB$,

if $x^2 = MD \cdot MB$.

But this latter is true and hence the above construction is valid.

II. *Solution by N. P. Pandya, Sojitra, India.*

Draw AP = given $\perp$. Draw a line $\perp$ AP, and let it be cut in X and D, respectively, by arcs with A as center and the angle-bisector, and the median as radii. Let DH ($\perp$PD) cut AX in H. Draw MO, the $\perp$ bisector of AH, to cut DH in O. With O as a centre and OA as radius describe a circle to cut PD in B and C. Then ABC is the required triangle. The proof follows easily from the fact that the bisector of the vertical angle of a triangle and the $\perp$ bisector of its base meet on the circumcircle. To find the area:

Δs APX, HDX are similar $\therefore AX : HX = PX : XD$.

$$\therefore HX = \frac{AX \cdot XD}{PX}.$$

Now $\overline{BD}^2 = \overline{BO}^2-\overline{DO}^2 = \overline{AO}^2-(\overline{XO}^2-\overline{XD}^2) = \overline{AO}^2-(\overline{XM}^2+\overline{MO}^2-\overline{XD}^2) = \overline{AM}^2-\overline{XM}^2+\overline{XD}^2 = AX \cdot HX+\overline{XD}^2 = AX \cdot \frac{AX \cdot XD}{PX}+\overline{XD}^2$

$$= \frac{\overline{AX}^2 \cdot XD}{PX}+\overline{XD}^2. \qquad (1)$$

Let $AP = p$, $AX = q$, $AD = m$.

$\therefore \overline{PX}^2 = \overline{AX}^2-\overline{AP}^2 = q^2-p^2$.

and $XD = \sqrt{m^2-p^2}-\sqrt{q^2-p^2}$.

$\therefore \overline{BD}^2 = m^2-2p^2+(2p^2-q^2)\sqrt{\frac{m^2-p^2}{q^2-p^2}}$, from (1). After reducing

$$\therefore \text{area} = BD \cdot AP = p\left[m^2-2p^2+(2p^2-q^2)\sqrt{\frac{m^2-p^2}{q^2-p^2}}\right]^{\frac{1}{2}}.$$

III. *Solution by W. M. Gaylor, Sag Harbor, N. Y.*

Denote the sides of the required triangle by a, b and c. Denote the median, angle-bisector, and altitude by m, t and h respectively. Suppose $a>b$ and c the base. Then $m>t>h$, and m and t lie on the same side of h as a, t between m and h. (The proof of these statements is simple and is not given. Moreover if $m = t = h$ the triangle, though isosceles, cannot be determined.) Denote the projections of m and t on c by p and q respectively.

Now, $a : b = \frac{1}{2}c+(p-q) : \frac{1}{2}c-(p-q)$.

By composition and division then squaring and solving for $(a+b)^2$ we have

$$(a+b)^2 = \frac{(a-b)^2c^2}{4(p-q)^2}. \qquad (A)$$

Also: $a^2+b^2 = \frac{1}{2}c^2+2m^2$

and $ab = t^2+[\frac{1}{2}c+(p-q)][\frac{1}{2}c-(p-q)]$.

Solving these two equations for $(a+b)^2$ we have

$$(a+b)^2 = c^2+2m^2+2t^2-2(p-q)^2. \qquad (B)$$

Equating the right hand members of A+B and solving for c:

$$c = 2(p-q)\sqrt{\frac{m^2+t^2-(p-q)^2}{m^2-t^2-(p-q)^2}}.$$

Denote the area of the required triangle by K.

Then $K = \frac{h}{2}\times c = h(p-q)\sqrt{\frac{m^2+t^2-(p-q)^2}{m^2-t^2-(p-q)^2}}.$ (C)

p and q may be expressed in terms of m, t and h. Substituting in C:

$$K = h(\sqrt{m^2-h^2}-\sqrt{t^2-h^2})\sqrt{\frac{h^2+\sqrt{m^2-h^2}\sqrt{t^2-h^2}}{h^2-t^2+\sqrt{m^2-h^2}\sqrt{t^2-h^2}}}.$$

A square of area K may easily be constructed from (C). First obtain $(p-q)$. Thus:

Upon an indefinite line AB erect at C a $\perp$ CD equal to h. With D as a center and m as a radius swing an arc cutting AB at E; with the same center and t as a radius swing an arc cutting AB on the same side of h at F. $EF = (p-q)$.

Construct a square S $\simeq$ rectangle $h\times(p-q)$.

Construct a square $\simeq m^2+t^2-(p-q)^2$. Denote its side by N. Construct a square $\simeq m^2-t^2-(p-q)^2$. Denote its side by M. Then N/M represents the radical part of the formula for K, and

$$K = S\times\frac{N}{M} \text{ that is } K:S = N:M$$

Whence K may be constructed. Denote its side by s

$$\text{Then } K = \frac{ch}{2} = s^2$$

$$\text{Whence } h : s = s : \frac{c}{2}.$$

From this $\frac{c}{2}$ may be constructed.

Lay off EG and EH from the foot of m along AB. Then DGH is the triangle required.

393. *Proposed by F. Eugene Seymour, Trenton, N. J.*

In Greenleaf's National Arithmetic are found the following directions for finding the area of a segment of a circle: Find the length of the chord. (Its distance from the center is given.) Take $\frac{3}{4}$ of its product by the height of the segment and add it to the cube of the height of the segment divided by two times the length of the chord. Discuss the accuracy of this method. (No solution has been received. See solution of Problem 220, by H. E. Trefethen, in the January, 1911, number of this journal.)

365. *Solution by Nelson L. Roray, Metuchen, N. J.*

Let r be the radius of the arc s whose chord is c and d be the altitude of the segment, also 2θ the central angle of s.

$$\text{Then } r = \frac{c^2+4d^2}{8d} \text{ and } r-d = \frac{c^2-4d^2}{8d}$$

$$\frac{c}{2r} = \sin\theta = \sin\frac{s}{2r}$$

$$\therefore c = s - \frac{s^3}{\underline{|3}\cdot(2r)^2} + \frac{s^5}{\underline{|5}\cdot(2r)^4} - \quad . \quad . \quad . \qquad (1)$$

$$\frac{c^2-4d^2}{c^2+4d^2} = \cos\frac{s}{2r}$$

$$\therefore \frac{c^2-4d^2}{c^2+4d^2} = 1 - \frac{s^2}{\underline{|2}\cdot(2r)^2} + \frac{s^4}{\underline{|4}\cdot(2r)^4} - \quad . \quad . \quad . \qquad (2)$$

$$\frac{s}{3}\cdot\frac{c^2-4d^2}{c^2+4d^2} = \frac{s}{3} - \frac{s^3}{\underline{|3}(2r)^2} + \frac{s^5}{3\underline{|4}(2r)^4} - \ldots \qquad (3)$$

Subtract (3) from (1) and substitute $r = \frac{c^2+4d^2}{8d}$

$$\text{we get } c = \frac{s}{3}\left(\frac{3c^2+4d^2}{c^2+4d^2}\right) - \frac{64d^4s^5}{45(c^2+4d^2)^4}\cdot$$

$$c = s - \frac{8d^2s}{3c^2} + \frac{32d^4s}{3c^4} - \text{something.}$$

This series is convergent and if c be replaced in second member by K, a value that makes the series still convergent the error in taking

$$c = s - \frac{8d^2s}{3K^2} \text{ is less than } \frac{32d^4s}{3K^4}$$

$$\therefore \text{ since } s > c, \text{ evidently}$$

$$\text{if } c = s - \frac{8d^2}{3s} \text{ the error is less than } \frac{32d^4}{3s^3}\cdot$$

Remark: A solution of this problem was also received from M. G. Schucker.

CREDIT FOR SOLUTIONS.

362. A. Singara Chariar. (1)

365. Nelson L. Roray, M. G. Schucker. (2)

366. M. G. Schucker. (1)

376, 377, 380, 382, 384, 385. A. Singara Chariar. (6)

389. Mabel G. Burdick. (1)

390. Mabel G. Burdick. (1)

391. Norman Anning, Katherine S. Arnold, Niel Beardsley, Mabel G. Burdick, John E. Campbell, Walter C. Eells (3), W. M. Gaylor, Walter G. Hopkins, C. M. Jhaveri, Michael J. Kaplan, N. P. Pandya, H. Polish, D. H. Richert, H. Roeser, Elmer Schuyler, P. K. Shah. (18)

392. Norman Anning, Katherine S. Arnold, Walter C. Eells, H. Roeser. (4)

393. Niel Beardsley, Walter C. Eells, G. I. Hopkins, N. P. Pandya, Oscar B. Scharrer, Elmer Schuyler. (6)

394. Norman Anning, William Feuerwerger, W. M. Gaylor, J. J. Ginsberg, G. I. Hopkins, N. P. Pandya. (6)

Total number of solutions, 46.

PROBLEMS FOR SOLUTION.

Algebra.

406. *Proposed by the Editor.*

If $\frac{p_n}{q_n}$ be the last convergent in the first period of $\sqrt{A}$ expanded as a

continued fraction, and r the integral part of $\sqrt{A}$, show that $p_n = rq_n + q_{n-1}$.
(Mathematical Visitor.)

407. *Proposed by Jacob P. Santer.*

What three equal discounts are equal to a discount of 48.8%?

Geometry.

408. *Proposed by Henry Smith, New York.*

If AB is a diameter of a circle, PQ perpendicular to AB from a point P on the circle and R is taken on AB so that AR = AP, show that QR is the radius of the circle touching PQ, QB, and arc PB.

Trigonometry.

409. *Proposed by N. P. Pandya, Sojitra, India.*

Two circles (centers P and Q) intersect one another orthogonally, and their radii are as 1 : 2. PQ cuts the minor arc of the smaller circle at R. A direct common tangent touches the circles at H and K. HK is produced to L, so that HL = 2HK. In the circumcircle of HLQ a chord LM = QR is placed, M being on the arc HQL. Show that HQ and HM are two of the decasectors of $\angle PHK$.

410. *Proposed by W. H. Thompson, Seattle, Washington.*

A series of poles of equal height are erected at intervals of 60 feet along a straight road. From a certain point the angles of elevation of the first, second, and fifth poles are 20, 37, and 10 degrees respectively. Find the height of the poles and the distance of the observer from the road.

SCIENCE QUESTIONS.

By Franklin T. Jones,
University School, Cleveland, Ohio.

Readers of School Science and Mathematics *are invited to propose questions for solution—scientific or pedagogical—and to answer the questions proposed by others or by themselves. Kindly address all communications to Franklin T. Jones, University School, Cleveland, Ohio.*

Problems for Solution.

167. *Proposed by Harvey Roeser, Stillwater, Okla. "A sort of sequel to the 'Problem of the Loaded Table' as discussed in* School Science and Mathematics."

Given a rigid rectangular platform supported by a spring balance at each of the corners A, B, C and D. The balances are all of the same pattern. Suppose a weight W placed on the table. Let the weight be moved parallel to the diagonal AC. Prove that the readings of the balances at B and D will not change.

168. *Proposed by W. L. Baughman, East St. Louis, Ill.*

A particle P is at rest at a point A on the uppermost point of a smooth vertical circle ABC. If the particle slides from rest, at what point in its path will it leave the circle?

Solutions and Answers.

144. *From Morgan & Lyman's Chemistry, p. 332, No. 3. (Macmillan.)*

The average family uses 20 tons of water in a year, one-tenth of which

is used with soap. If the water is hard and contains .01 per cent of calcium sulphate, what is the approximate value of soap wasted each year, supposing soap to be $NaC_{18}H_{35}O_2$? (A 5-cent cake of soap weighs about 10 ounces and often contains 40 per cent of water.)

Solution by W. C. Phebus, Lorain, Ohio.

If 20 tons is total water, 2 tons=4000 lbs. is used with soap.

$4000 \times .0001 = .4$ lb. $CaSO_4$.

$$2NaC_{18}H_{35}O_2 + CaSO_4 \rightarrow (C_{18}H_{35}O_2)_2Ca + Na_2SO_4$$

$$\begin{matrix} 612 & & 136 \\ x & & .4 \text{ lb.} \end{matrix}$$

$x = 1.8$ lb. of 100% soap, which is equivalent to 3 lbs. of 60% soap, or 48 oz., or 4.8 cakes of soap. At 5¢ per cake the cost would be *24 cents.*

145. *Proposed by the Editor.*

The average hardness of the water of Cleveland is 13.6 parts per million of which about half may be remedied by water softening on the large scale proposed by the new filtration system. Assume the average water consumption at 100 gallons per day per person and the number of people served by the Greater Cleveland Water Works system at 750,000, also that one-one-hundredth only is used with soap. Using the same data for soap as in problem 144, what will be the annual saving in soap alone?

Answer, $8,935.20. Is it correct?

150. *Proposed by a student in West High School, Minneapolis, Minn., through Miss Jessie Caplin, Teacher*

Why is the following statement correct:

Weight of 1 liter of a gas = $\frac{1}{100}$ molecular weight+specific gravity referred to air as a standard?

Solution by Roger Gannet, West High School, Minneapolis, Minn.

$$\text{Given wt. of 1 liter} = \frac{\text{mol. wt.}}{100} + \text{sp. g.} = \frac{\text{mol. wt.}}{100} + \frac{\text{mol. wt.}}{2 \times 14.4} =$$

$$\frac{28.8 \times \text{mol. wt.} + 100 \times \text{mol. wt.}}{2880} = \frac{128.8 \text{ mol. wt.}}{2880} = \frac{1422 \text{ mol. wt.}}{2880} \times .09 =$$

$$\frac{\text{mol. wt.}}{2} \times .09.$$

151. *Problem from a Physics list used in South High, Pittsburgh, Pa.*

A gasoline launch of 1,000 kilograms mass is running in still water, 9 kilom per hr. The engine is stopped and the resistance of the water brings the boat to rest in 50 sec.—Find

(a). The distance the boat goes before coming to rest.

(b). The average resistance in dynes.

(c). The amount of work done in ergs, by the water resistance in stopping the boat.

(d). The K. E. the boat possessed in ergs, when the engine was shut off (15%).

Answers. (a) Distance = 6250 cm. (b) Force = 5,000,000 dynes. (c) Work = 31,250,000,000 ergs. (d) KE = 31,250,000,000 ergs.

152. *Hoisting Crane.*

The load lifted is 20,000 pounds. The tie beam is set at an angle of 45 degrees with the upright. The rope over the pulley in the end of the tie rod, is at an angle of 90 degrees with the upright. Find the tension in the rope and the compression in the tie rod. Use scale; one cm. equal 200 pds. (15%).

Answers: Tension 2000 lbs. Compression 2828 lbs.

153. The new steel barges made by Jones and Laughlin, are 200 feet

long, 26 feet wide, 8 feet 8 inches deep, and weigh 130 tons. The Monongahela river water has a density of 1.002. How many tons of coal can one carry, when loaded so that it sinks 6 feet? (15%).

Solution by H. C. Trimble, Peoria, Ill.

$200\times26\times6\times62.5\times1.002 = 1{,}953{,}900$ lbs. wt. of water displaced. Weight of barge is 130 tons = 260,000 lbs. Hence coal weighs the difference, or 1,693,900 lbs. = 846.95 tons. Ans.

154. *Proposed by Karl Zeller, Pittsburgh, Pa.*

It was found in the laboratory that the efficiency of a jack screw was 25%. The buildings in the hump district were raised with jack screws, while new cellar walls were being constructed. If each jack screw was equipped with a 14-inch lever, had 4 threads to the inch and exerted a lift of 2,400 pounds, what force did a man have to use at the end of the lever? Use 3 and $\frac{1}{7}$ for the value of 3.1416. (15%).

Solution by H. C. Trimble, Peoria, Ill.

Work out = $2400\times\frac{1}{48} = 50$ foot lb.

Work in = $\frac{1}{4}\times\text{force}\times1\frac{1}{6}\times6\frac{2}{7}$.

Since work out = work in, Force = $27\frac{3}{11}$ lb.

155. Each pump at the South Side Station, Pittsburgh, Pa., lifts 7,000,000 gallons of water 360 feet high in 24 hours. A gallon of water weighs 8.3 pds. If the efficiency of the pump is 90%, what is its horse power? (10%).

Solution by H. C. Trimble.

$7{,}000{,}000\times360\times8.3$ lbs. = 20,916,000,000 lbs., the weight of water lifted. In 24 hours there are 1440 minutes and 33,000 ft. lbs. (1 h. p.) per minute = 1,570,000 ft. lbs. per day. $\frac{20{,}916{,}000{,}000}{47{,}520{,}000} = 440.15$ h. p. to lift water. If pump is 90% efficient then 440.15 = 90% of h. p. of pump. $100\% = 489+h.\ p.$ Ans.

156. *Proposed by Karl Zeller.*

A 1,000 gram iron ball, sp. ht. 0.11, is placed in the flue of a furnace. After it has absorbed enough heat to become the same temperature as the flue gases, it is dropped into 4,000 grams of water at 15 degrees C. The resulting temperature is 30 degrees C. What was the temperature of the flue gases? (20%).

Solution by H. C. Trimble.

4000×15 = gm. cals. taken on by water or 60,000. If x was temperature of ball in flue, then $x-30°$C. = degrees change when put in water. Then $1000\times.11\times(x-30°)$ = cals. given off.

Then $1000\times.11\times(x-30°) = 60{,}000$.

Solving $x = 575.4°$C.

ARTICLES IN CURRENT PERIODICALS.

American Forestry for September: *Washington, D. C.; $2.00 per year, 20 cents a copy:* "The War and the Lumber Industry," Bristow Adams, with seven illustrations; "The Bavarian Forester," G. H. Collingwood, with six illustrations; "The World's Greatest Woodlot," Geo. S. Long, with six illustrations; "National Forests as Recreation Grounds," W. J. Morrill, with six illustrations; "The Glaciers of Mt. Rainier," F. E. Matthes, with eighteen illustrations; "Logging a River Bottom," Edward F. Bigelow, with five illustrations; "Handling Lumber by Cableway," with one illustration; "A Roadside Tree Law," Chapin Jones; "The World's Largest Tree Trunk," with one illustration; "Fire Protection in California," Knowlton Mills, with four illustrations.

American Journal of Botany for July; *Brooklyn Botanic Garden, Brooklyn, N. Y.; $4.00 per year, 50 cents a copy:* "Investigations on the Phylogeny of the Angiosperms. I. The Anatomy of the Node as an Aid in the Classification of Angiosperms," Edmund W. Sinnott; "Studies of the Development of the Piperaceae. II. The Structure and Seed-Development of Peperomia Hispidula," Duncan S. Johnson; "A Gloeosporium Disease of the Spice Bush," J. J. Taubenhaus; "The Origin and Development of the Lamellae in Corprinus Micaceus," Michael Levine.

American Mathematical Monthly for September; *5548 Kenwood Ave., Chicago, Ill.; $2.00 per year:* "The Apparent Size of a Cube," A. M. Harding; "Residues of Certain Sums of Powers of Integers," T. M. Putnam; "Miscellaneous Questions," edited by R. D. Carmichael.

American Naturalist for August; *Garrison, N. Y.; $4.00 per year, 40 cents a copy:* "Multiple Allelomorphs in Mice," T. H. Morgan; "Thirteen Years of Wheat Selection," T. B. Hutcheson; "Pattern Development in Mammals and Birds," Glover M. Allen; "The Meadow Jumping Mouse," Dr. H. L. Babcock.

Condor for September-October; *Hollywood, Calif.; $1.50 per year, 30 cents a copy:* "The Nesting of the Spotted Owl (with seven photos by the author)," Donald R. Dickey; "Notes on a Colony of Tri-colored Redwings," Joseph Mailliard; "Bird Notes from the Sierra Madre Mountains, Southern California," H. Arden Edwards; "A study of the Status of Certain Island Forms of the Genus *Salpinctes*," H. S. Swarth; "A Survey of the Breeding Grounds of Ducks in California in 1914 (with nine photos by the author)," Harold C. Bryant; "A Method of Cleaning Skulls and Disarticulated Skeletons," F. Harvey Holden.

Journal of Geography for September; *Madison, Wis.; $1.00 per year, 15 cents a copy:* Geography in City High Schools," R. H. Whitbeck; "Crater Lake," James F. Chamberlain.

L'Enseignement Mathématique for July-September; *Stechert & Co., West 25th Street, New York; 15 francs per year, 3 francs per copy:* "Compte Rendu de la Conférence Internationale de l'Enseignement Mathématique, Paris, 1-4 avril, 1914. A. Les résultats obtenus dans l'introduction du Calcul différentiel et intégral dans les classes supérieures de l'enseignement secondaire. (Five reports and discussions.) B. La préparation mathématique des ingénieurs dans les différents pays. (Report and three discussions)"; "Points-pinces, Arêtes de rebroussement et représentation paramétrique des surfaces," J. Hadamard; "Sur deux applications des coordonnées intrinsèques," L. Braude; "Remarque sur les points d'inflexion dune cubique à point double," B. Bydžovsky. (This number 5 fr.)

Nature-Study Review for September; *Ithaca, N. Y.; $1.00 per year, 15 cents a copy:* "Foreword"; "Cricket Music," Mrs. Anna B. Comstock; "Nature Study in Art," C. H. Robison; "Nature Study in City Parks," N. E. Nelson; "Nature Study and the Teacher," John Voaden; "A Rare Deformity in a Painted Turtle," R. W. Shufeldt; "Out of Doors in Doors," Helen M. Reynolds; "Animal Life in Prairie Ponds," T. H. Hankinson; "School Gardening in the South," E. A. Miller.

Physical Review for September; *Ithaca, N. Y.; $6.00 per year, 50 cents a copy:* "Some Effects of Diffraction on Brightness Measurements made with the Holborn-Kurlbaum Optical Pyrometer," A. G. Worthing and W. E. Forsythe; "The Effect of Pressure on the Absorption of Light by

Bromine and Chlorine, and its Theoretical Significance," David L. Webster; "On the Asymmetric Emission of Photo-Electrons from Thin Films of Platinum. I," Otto Stuhlmann, Jr.; "The Factors which Determine the Quantity of Roentgen Radiation Given off by an X-Ray Tube," Wheeler P. Davey; "The Mean Depth of Formation of X-Rays in a Platinum Target," Laura G. Davey; "A New Design of Flicker Photometer for Laboratory Colored Light Photometry," Herbert E. Ives and Edw. J. Brady; "A Study of Contact Potentials and Photo-electric Properties of Metals in Vacuo: and the Mutual Relation between these Phenomena," Albert E. Hennings; "A Study of the Magnetic Qualities of Stressed Iron and Steel," C. M. Smith and Geo. W. Sherman, Jr.

Popular Astronomy for August-September; *Northfield, Minn.; $3.00 per year, 25 cents a copy:* "George William Hill," F. R. Moulton; "Shooting Stars," Charles N. Holmes; "A Curious Variety of Meteor," W. F. Denning; "The Completing of an Eclipse Cycle"; "Monthly Report on Mars, No. 6," William H. Pickering; "An Investigation of the 9.4-inch Objective of the Shattuck Observatory of Dartmouth College," H. T. Stetson; "The Total Lunar Eclipse of March 22, 1913," Albert S. Flint; "The Probable Effect of Radioactivity on the Death-Rate of the Sun," W. Carl Rufus; "Story of the Cawthron Solar Observatory Project," Mary Proctor; "A Summary of the Astronomische Gesellschaft Catalog," Louise F. Jenkins.

Popular Science Monthly for September; *Garrison, N. Y.; $3.00 per year, 30 cents a copy:* "An Expedition to the Coral Reefs of Torres Straits," Alfred G. Mayer; "The Cellular Basis of Heredity and Development," Edwin G. Conklin; "The Decreasing Population of France," James W. Garner; "The Rise of a New Profession," Edward D. Jones; "The Picture and the Text," Robert MacDougall; "Determining Educational Values," M. V. O'Shea; "The Paradox of the East Wind," Alexander McAdie.

Unterrichtsblätter für Mathematik und Naturwissenschaften, Nr. 5; *Otto Salle, Elssholzstr. 15, Berlin W. 57, Germany; M. 4 per year, 60 Pf. per copy:* "Physik und Philosophie," Friedrich Poske; "Die Bedeutung der angewandten Mathematik für die Schule," Geh. Rat Prof. Dr. Runge; "Elementare Inhaltsberechnung der Rotationskörper der Kegel schnitte," Dr. Rudolf Hunger; "Bemerkungen zu dem Aufsatze: Die Brille im Unterricht," Wilhelm Hillers; "Unformung goniometrischer Funktionen von Winkelsummen," A. Scheins.

Zeitschrift für den Physikalischen und Chemischen Unterricht for July; *Prof. Dr. F. Paske, Berlin-Dohlen, Friedbergstrasse 5; 6 numbers, $2.88, 12 M per year:* "Apparat zur Demonstration der Phasenverschiebung und von Resonanzerscheinungen in Wechselstromkreis," H. Lohmann; "Demonstrationsapparat für Energieübertragung," H. Lohmann; "Über die Verwendung von Wechselstrom höherer Spannung im Experimental-Unterricht," A. Zillich; "Schülerübungen mit einem einfachen physischen Pendel," O. Michaelis; "Kapillarschwimmer aus Aluminiumblech," H. Rebenstorff; "Versuche zur Brechung des Lichtes durch verdünnte Luft und durch andere Gase," P. Luckey; "Noch einmal die Coriolissche Kraft," O. Wiener. Kleine Mitteilungen: "Versuchsanordnung zur Zurückwerfung und Brechung des Schalles und zur 'Durchhörigkeit,'" A. Stroman; "Zur Umkehrung der Natriumlinie," W. Volkmann; "Tonerzeugung durch Wechselwirkung von Telephon und Mikrophon," O. Kremla; "Über ein neues Glasfadenelektrometer," P. Bräuer; "Über einen zur Messung oder Vergleichung kleiner Flüssigkeitswiderstände geeigneten Induktionsapparat," P. Bräuer; "Der Kohle-Detektor im Unterricht," H. Kellermann; "Zur Bestimmung des Volumverhältnisses zwischen Knallgas und Wasserdampf," C. Hauschulz.

AN N. E. A. REPORT ON HIGH SCHOOL SCIENCE.

At the St. Paul meeting of the N. E. A., the committee on biological subjects, which is a part of the Commission on the Reorganization of Secondary Education, made a preliminary report from which we quote a passage which is of interest in connection with present discussion as to "general science." This committee is composed of seventeen members, representative of all parts of the country, and has been actively at work for over a year.

"The committee maintains that *unity of subject matter in any course in science is of first importance*, by which is meant that the subject matter should be so organized that appreciation of *underlying principles* shall form the foundation of the student's knowledge, thus giving him a scientific basis for the organization of his knowledge."

"The committee unanimously agree that *a two-year course in elementary science* should be the basis for the more advanced courses. In such a two-year course the following is our suggested content of basic material: *physical environment* (including a study of matter and forces), *plants, animals* (including man), *applications of science to human welfare and convenience*. If administrative conditions prevent a two-year course required, we recommend the first-year course required, and the second elective. *We do not recommend a one-year course which attempts to cover the whole field of elementary science.*"

The general part of the report is followed by a series of appendices in which the principles laid down are discussed from various angles, and suggestions made as to content for the various units proposed. Some of these appendices have been formally adopted while others are still being discussed. One of the latter, which touches the question of general science, is the following:

The principal question in the organization of high school science is the question as to what shall be the nature of the science placed early in the program and made a general requirement. Here we find an issue between those who ask for a rather vague thing called "general science" and those who adhere to "special science" as preferable.

It will be noted that in this matter the committee takes middle ground. In the two-year course which it advocates "special science" in any rigid sense has been eliminated. This two-year course may quite properly be called a course in general science. In it the materials of science are to be organized primarily in terms of their effective appeal to the pupil and not primarily in terms of the organization of separate sciences. Physics, chemistry, botany, and zoölogy with their connotation of organization in terms of *science* are words which do not appear. Instead we have *physical environment, plants, animals*, and *man* with connotation of organization in terms of the *pupil*.

On the other hand, through these rather specific divisions of the subject matter, it is believed that *real* scientific unity may be preserved. *Such* unity the committee has attempted to define, and it is of the opinion that the preservation of such unity is essential. Not essential because of science, but essential because of the child. It matters little whether our subject be rightly named science or not, and the committee seeks to preserve nothing because its loss would disqualify our subject as science. But it does seek to preserve such unity because it believes that with its loss the best values of science to the child are lost. The committee also holds that the preservation of such unity in no wise impedes granting in full measure the demand that our science courses be more practical, more "in terms of everyday experience." And finally the committee is convinced that teachers today are better equipped to teach a course which re-

spects the natural divisions of science than they are to teach one which frankly abandons such divisions. The "failures" in science instruction have been due to faults in teaching and to faults in choice of subject matter rather than to faults in principles of organization. So these "failures" are not to be diminished and they may be increased by abandonment of the principles of organization.

It is believed that one-year courses in general science, as now presented, are deficient in such organization of data as is held to be of first importance. It is believed that unity which rests on unity of experience (including "the pupil's interests"), or on contiguity of material, is not real unity in the sense that is needed in the pedagogy of science. It is believed that the one-year course which ranges freely over the whole field is deficient in giving such grasp of principles and organization of data as are essential to the best which a science course can give to a pupil. Such courses are an invasion of the high school by the nature-study of the grades. High school pupils have reached an age at which organization of data appeals to them. We should not neglect the advantage which lies in this fact. We should not present interesting miscellanies when we can make equally strong appeal through an organization which does more for permanent grasp, for appreciation, and for application. Hence the committee has sought to preserve what seems to it best in the present organization of the science courses, and at the same time to satisfy reasonable demands for a closer linking of science with the child's life.

THE ANNUAL MEETING OF THE CENTRAL ASSOCIATION OF SCIENCE AND MATHEMATICS TEACHERS.

The fourteenth annual meeting of the Central Association of Science and Mathematics Teachers will be held at Chicago in the magnificent new building of the Hyde Park High School, November 27th and 28th, the Friday and Saturday after Thanksgiving.

Plans for the meeting are practically completed. These will provide one of the most helpful and timely programs ever presented by the Central Association. The pronounced success of the practical program of last year, which had as its central theme "Vocational Courses in Science and Mathematics," has been an incentive to those who have planned the coming program. The consideration of this theme is continued as a part of the general topic for the next meeting, *"Problems Arising in Adjusting Applied Science to High School Curricula."*

The fundamental importance of properly applying the science and mathematics taught in our high schools is realized today as never before by progressive teachers. The place and purpose in high school curricula of courses in agriculture, domestic science, and vocational subjects are matters not clear as yet in the minds of many teachers and others interested in education. These subjects will be discussed both in the general sessions and in the section meetings by many of the ablest and most prominent teachers of the country.

Among the *prominent educators* who will appear upon the program are: Eugene Davenport, Dean of the Department of Agriculture, University of Illinois. Miss Van Renssalear, Head of the Department of Home Economics, Cornell University, Ithaca, N. Y. Mrs. Ella Flagg Young, Superintendent of Schools, Chicago. Otis W. Caldwell, Dean

of University College, University of Chicago. Miss Abby Marlatt, Head Department of Home Economics, University of Wisconsin. Benjamin M. Davis, Professor of Agricultural Education, Miami University. E. A. Strong, State Normal School, Ypsilanti, Mich. Walter S. Tower, Department of Geography, University of Chicago. G. A. Miller, Department of Mathematics, University of Illinois. Willis E. Johnson, President State Normal School, Ellendale, North Dakota. Louise Stanley, Head of Department of Home Economics, University of Missouri. H. E. Cowles, Department of Botany, University of Chicago. Mrs. W. S. Hefferan, Vice President of the National Education Association, Chicago. Miss Marie Gugle, Supervisor of High Schools, Columbus, Ohio. Emma Conley, State Inspector of Domestic Science for Wisconsin. Harvey N. Davis, Professor of Physics, Harvard University.

Excursions. An interesting and valuable feature of the meeting will be a series of excursions arranged for Saturday afternoon. Twelve trips have already been arranged for and more are in prospect.

Each of the five original sections of the Central Association, Biology, Chemistry, Earth Science, Mathematics, and Physics has had a strong program prepared for it by the officers elected at the Des Moines Meeting. The addresses and discussions of the several sessions will appear in the *Proceedings* of the meeting, to be issued after the close of the meeting.

An unusual effort is being made at this time to make the coming meeting of the Central Association, the largest and most influential in its history. Every teacher of science and mathematics in the Central States should begin to plan now to attend the Central Association Meeting, November 27th and 28th.

For programs and additional information write the Secretary, Mr. W. L. Eikenberry, University High School, University of Chicago.

THANKSGIVING MEETING OF HOME ECONOMICS TEACHERS.

A meeting of high school home economics teachers is to be held in Chicago at Hyde Park High School, Nov. 27 and 28, 1914. The Central Association of Science and Mathematics Teachers, a well-known organization of college and high school teachers, has recently established a section for us. The following programs have been arranged for these section meetings:

FRIDAY AFTERNOON, NOV. 27.

Round Table discussion, Home Making and Housekeeping Courses in High School; introduced by five-minute papers, as follows:

Household Management, Miss Bernice Allen, High School Department, School of Education, University of Chicago.

Teaching Food Work through Preparation of Meals, Miss Agnes Wilson, Housekeeping Center of Stockyards district, Chicago.

House Decoration, Miss Isabel Clark, Director Household Arts Department, Beach Manual Training School, Oshkosh, Wis.

High School Dietetics, Miss Ada Hillier, Supervisor of Household Arts School, City of South Bend, Ind.

The High School Lunch Room Class, Mrs. Helen M. Sabin, Lucy Flower Technical High School, Chicago. Discussion by Miss Grace Hood, Director of Domestic Science, Lewis Institute, Chicago.

Testing of Textiles for High School Girls, Miss Julia Tear, Hyde Park High School, Chicago.

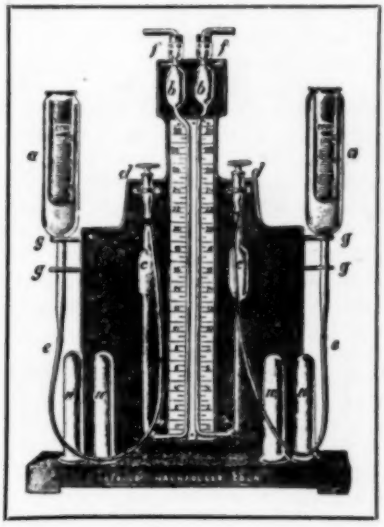
Drafting of Dress Patterns, Miss Agnes Hanna, School of Education, University of Chicago.

E. Leybold's Nachfolger
COLOGNE (GERMANY)

SCIENTIFIC INSTRUMENT MAKERS

Grand Prize of World's Exhibition, Brussels, 1910, and Turin, 1911, High Honors

INSTRUMENTS OF PRECISION. ALL KINDS OF PHYSICAL APPARATUS



Looser's and Kolbe's Thermoscopes with all Accessories

Dr. Gaede's High Vacuum Pumps
Vacuum 0.00001 mm Hg.

Universal Rotary Air Pumps
Vacuum 0.01 mm Hg.

Vacuum Gauges, Etc.

Delivery free from New York or Baltimore. Guarantee of delivery in working condition. Discharge of all formalities at the Customs. English Catalogue with Prices in $ sent on application.

SATURDAY MORNING, NOV. 28.

Mutual Relations to be established between Home and Home Economics Class Room, Mrs. W. S. Hefferan, Chicago.

School Credit for Home Work, Miss Grace Schermerhorn, Director Practice Teaching Home Economics, Iowa State College. Discussion by Miss Marlatt, Head of Department of Home Economics, University of Wisconsin.

Home Project Work in Southern Schools, Miss Louise Stanley, Chairman of Home Economics, University of Missouri.

High School Food Work,—What besides Manipulation? Miss Emma Conley, High School Inspector of Domestic Science, State of Wisconsin.

Besides these two section meetings, there are papers to be presented in chemistry, physics, and other sections, which will be of interest to home economics teachers. Especially is this true, since the general topic for the 1914 meeting is "Problems Arising in Adjusting Applied Science to High School Curricula." One of the addresses at the general meeting Friday morning is, "Place of Home Economics in Secondary Education," by Miss Martha van Rennselaer, of Cornell University.

An excellent series of moving picture films to illustrate textile manufacturing processes, presented under the auspices of the Marshall Field firm, is promised for Saturday afternoon; also, their various textile exhibits will be open to teachers, and will be explained by Mrs. Genevieve Reid, lecturer on textiles to Marshall Field employes.

Other features of the section meetings in home economics will be: An exhibit of notebooks, to which all are cordially invited to contribute, in charge of Mrs. Hubbell of Englewood High School, Chicago; an exhibit of text-books and other literature, of charts and illustrative material to be had from commercial sources, in charge of Miss Jenny Snow, Chicago Normal College; an exhibit of household appliances, in charge of Miss Florence Norton, Chicago public schools.

The home economics committee of C. A. S. and M. T. has been allotted a few pages in October, November and December numbers of SCHOOL SCIENCE AND MATHEMATICS, the official organ of the association. Some of the articles already published or soon to be published are: Elementary Food Work Brought into Relation with Preparation of Meals, by Alice Titsworth Houston; A High School Home Nursing Course, by Anne Green; The Bed, Its Equipment and Care, by Minna C. Denton; Experimental Lesson in Baking Powders for High School Girls, by Grace Hood; Testing Market Values of Coffee, by Georgia Finley; Judging the Kitchen, by Thos. E. French; a series, "Some Common Errors Heard in Home Economics Class Rooms." At the Saturday morning business meeting the question of a home economics journal for high school teachers, or of the establishment of a department for them in some already existing journal, is to be discussed.

All home economics teachers who can be in Chicago Thanksgiving week are cordially invited to attend this meeting; all are invited to become members and subscribers to our publications.

Membership fee, $1.50. Address H. R. Smith, Treasurer, Lake View High School, Chicago.

Committee on organization: Minna C. Denton, Ohio State University; Jenny H. Snow, Chicago Normal College; Bernice Allen, University of Chicago; Mildred Weigley, De Kalb Normal; Julia Tear, Hyde Park High School, Chicago; Mrs. Hubbell, Englewood High School, Chicago.

NEW WESTON

Instrument Transformers

Portable and Switchboard

The New Weston Current & Portable Transformers are capable of serving the highest degree of precision under the widely ranging conditions incidental to practical use. They are of convenient size and reasonable cost. No other instrument transformers equal them in precision, in design, in workmanship and reliability in service. BULLETIN 2001 describes portable type—BULLETIN 1501 describes switchboard types.

Weston Electrical Instrument Company

Newark, N. J.

New York, Philadelphia, Boston, Denver, Cleveland, Richmond, Montreal, Chicago, San Francisco, St. Louis, Detroit, Atlanta, Toronto, Vancouver, London, Eng., Berlin, Germany.

Laboratory Apparatus

Physics, Chemistry, Biology, Agriculture

STANDARD SCIENTIFIC COMPANY · STANDARD · NEW YORK ·

Large Stock Reasonable Prices
Orders Carefully and Promptly Shipped

Send for our catalogs: STANDARD LABORATORY APPARATUS; STANDARD PHOTOGRAPHIC APPARATUS and SUPPLIES; HANDBOOK of STUDENT APPARATUS for the experiments in modern laboratory courses and manuals of PHYSICS; Bulletin No. 1 NEW LABORATORY APPARATUS; Bulletin No. 2 PRATT APPARATUS.

STANDARD SCIENTIFIC COMPANY

147-153 Waverly Place NEW YORK

BOOKS RECEIVED.

The Thirteenth Year Book of the National Society for the Study of Education. Part II. Plans for Organizing School Surveys with a Summary of Typical School Surveys, by H. S. Smith, Bloomington, Ind., and Charles H. Judd, University of Chicago. 85 pages. 18x22.5 cm. Paper. 1914. 75c net. The University of Chicago Press.

Handbook of Practice for Teachers, Practical Directions for Management and Instruction, by Charles A. McMurry, Normal School, De Kalb, Ill. Pages xi+141. 13x19 cm. Cloth. 1914. 60c. The Macmillan Company, New York.

State and County Educational Reorganization, by Ellwood P. Cubberley. Pages xx+257. 14x20.5 cm. Cloth. 1914. $1.25. The Macmillan Company, New York.

The Weather and Climate of Chicago, by Henry J. Cox and John H. Armington, U. S. Weather Bureau. Pages xxv+375. 17.5x24 cm. Cloth. 1914. $3.00 net. The University of Chicago Press.

The Walsh-Suzzallo Arithmetic, by John H. Walsh, Associate Superintendent of Schools, New York City, and Henry Suzzallo, Columbia University. Book One—fundamental processes. Pages x+246. 13x19 cm. Cloth. 1914. Book Two. Pages x+518. 13x19 cm. Cloth. 1914. D. C. Heath and Co., Boston.

Laboratory Studies in Mammalian Anatomy, by Inez W. Wilder, Smith College. Pages xi+156. 15.5x22.5 cm. Cloth. 1914. $1.25. P. Blakiston's Son and Co., Philadelphia.

Textiles, by William H. Dooley. Lowell, Mass., Industrial School. Pages xii+329. 14x19 cm. Cloth. 1914. $1.25. D. C. Heath and Company, New York.

Family Expense Account, by Thirmuthis A. Brookman, Oakland, Cal. Pages vi+97. 19.5x15 cm. Cloth. 1914. D. C. Heath and Company, New York.

Experimental Studies in Electricity and Magnetism, by Francis E. Nipher, Washington University, St. Louis. 73 pages. 16x24 cm. Cloth. 1914. $1.25. P. Blakiston's Son and Co., Philadelphia.

Foundations of Chemistry, by Arthur A. Blanchard, Mass. Institute of Technology and Frank B. Wade, Shortridge High School, Indianapolis. 446 pages. 13x19 cm. Cloth. 1914. American Book Company, Chicago.

Introduction to Organic Chemistry, by John Tappan Stoddard, Smith College. Pages ix+419. 13x19 cm. Cloth. 1914. $1.50. P. Blakiston's Son and Co., Philadelphia.

The Theory of Numbers, by Robert D. Carmichael, Indiana University. 94 pages. 15.5x23.5 cm. Cloth. 1914. $1.00. John Wiley and Sons, New York.

Elements of General Science, by Otis W. Coldwell, University of Chicago, and William L. Eikenberry, University High School, University of Chicago. Pages xiv+308. 14x20 cm. Cloth. 1914. $1.00. Ginn and Company, Chicago.

Laboratory Physics for Secondary Schools, by Robert A. Millikan and Henry G. Gale, University of Chicago, and Edwin S. Bishop, School of Education, University of Chicago. Pages vi+135. 20.5x27 cm. Cloth. 1914. 50 cents. Ginn and Company, Chicago.

Examples in Algebra, by Albert H. Wheeler, High School of Commerce, Worcester, Mass. Pages xiii+257. 13.5x20 cm. Cloth. 1914. 90 cents. Little, Brown and Company, Boston.

The 'Varsity

ELECTRIC OVEN

With Regulator

Price, $30.00 Net

Designed to meet the need of an inexpensive satisfactory electric oven for university and college laboratories requiring a number of ovens to replace the unsatisfactory gas-heated copper ovens, the use of which is rapidly passing.

SPECIFICATIONS.

Size of Chamber: 10x12 in.
Range:—Few degrees above air to 150° C.

Construction:—Of heavy asbestos wood with cast aluminum frame and door; cast aluminum racks allowing the perforated aluminum shelves to be placed at any desired height. Easily removable and correctly wound heating plate. Metallic regulator holding temperature to within a degree. Electric lamp to indicate when current is *made* and *broken*.

The only low-priced students' oven that has no parts unsuited to severe laboratory usage. Constructed for long service.

EIMER & AMEND

FOUNDED 1851

Headquarters for Educational and Industrial Laboratory Supplies

NEW YORK CITY
205-211 Third Ave.

PITTSBURGH, PA.
3006 Jenkins-Arcade Bldg.

BOOK REVIEWS.

The Parent's Guide in Sex Problems, by Dr. B. J. Kendall. 283 pages. 11x16.5 cm. Cloth. $1.00. B. J. Kendall, Geneva, Ill.

One of the best books published on this most important subject. The treatment is masterful, tells things that every boy and girl, man and woman, should know about, concerning themselves and their descendants. It is a book which should be in the hands of every person, over ten years of age, whether afflicted with any sexual disease or not. Friends, get the book, read and study it carefully, then teach others of the lessons which you will have learned from it. C. H. S.

The Tangible Rewards of Teaching—A Detailed Statement of Salaries Paid to the Several Classes of Teachers and School Officers. Compiled by James C. Boykin and Roberta King. Pages 461+iv. 14x23 cm. Paper. 1914. U. S. Bureau of Education. Bulletin 589, Government Printing Office, Washington.

This is a publication which every person who is to become familiar with the teacher salary question in this country must possess. It is a compilation of all the available information bearing on this subject. It is put together in splendid shape. The tables are splendidly arranged. There is a very complete bibliography of 21 pages. The book is indexed. It is surely a valuable contribution to the literature on this subject. C. H. S.

News, Ads and Sales, the Use of English for Commercial Purposes, by John B. Opdycke, Julia Richman High School, New York. Pages xiii+193. 14x21 cm. Cloth. 1914. $1.25. The Macmillan Co., New York.

One receives an inspiration worth while when reading and studying a book of this character. The author has produced a book adapted to the absolute needs of the great majority of our high school pupils, especially those in the last two years of the course. It is a laboratory manual in English, bringing the pupil into direct and immediate contact with the way in which his language is now actually used in the great commercial world. The pupil is taught how to use and understand English as it is used in the newspaper, magazine and in the numerous forms of advertising schemes.

The plan and scope of the book is to give the pupil a comprehensive view and understanding of the newspaper in all of its various phases, as a compiler and dispenser of news. Many plans and suggestions are given the teacher who will find them worth while to follow. The newspaper journals of various kinds, advertising schemes, commercial and market reports and general salesmanship literature should be used as laboratory material in connection wth the use of the text.

The way in which a newspaper is made in all of its various phases, from the source of the news to the reader is splendidly outlined. Many typical news heads and advertisements are given in the body of the text. Numerous review and general questions as well as theme topics are incorporated in the book. A bibliography of books on Journalism is printed. A good index is appended. The book mechanically is well made, being printed in heavy ten point type on an excellent quality of paper. It should have a wide and extensive use. C. H. S.

Handbook of Practice for Teachers. Practical Directions for Management and Instruction, by Charles A. McMurry, Normal School, DeKalb, Ill. Pages xi+141. 13x19 cm. Cloth. 1914. 60c. The Macmillan Company, New York.

A splendid, helpful and instructive book for the use of all grades of teachers on the "don't's and do's" of the teaching profession. A careful and sane study of this manual will enable any "rutted" teacher to recognize her faults and help her to place herself on a road broad enough to accommodate herself to any grade of pupils who may come before her for

General Science

has found increasing favor as a first-year high-school study, and is at present used in many high schools throughout the United States. Such a course discusses many topics of common interest and worth-while significance in the field of science—topics which contribute directly towards developing scientific methods of thinking and towards forming a basis for later science work.

ELEMENTS *of* GENERAL SCIENCE

By Otis W. Caldwell and William Lewis Eikenberry of the School of Education, the University of Chicago, 308 pages, illustrated, $1.00, meets a long-standing need in schools presenting general science courses. In four days following its recent publication, the publishers received thirty introductory orders for some 2000 books—tangible evidence that teachers are recognizing the value of a course which is the outcome of actual teaching and experiment in classroom and laboratory. For the past four years the course has been given, essentially as now published, in the University High School, the University of Chicago.

Elements of General Science is worth investigation. Send for special descriptive circular.

Ginn and Company: Publishers

BOSTON ATLANTA NEW YORK DALLAS CHICAGO COLUMBUS LONDON SAN FRANCISCO

EXAMPLES IN ALGEBRA

By ALBERT HARRY WHEELER, Author of "First Course in Algebra," and Teacher of Mathematics in the High School of Commerce, Worcester, Massachusetts.

This book of examples is to be used with any high school textbook. It contains 10,000 exercises of the most modern character, and is designed to supply the need for extra material to be used in connection with the text-book proper. The demand for a book of examples such as this has been increasing, for the very few books of its sort now in existence have become antiquated.

Simplicity is the keynote of the work. The book is full of "one-step-at-a-time" problems; it is carefully graded from beginning to end. At least one-third of the examples consist of mental exercises. Many purely arithmetical problems are given, and the two subjects of arithmetic and algebra are constantly related. Sets of preparatory examples, introducing such topics as factoring, fractions, etc., are given. These preparatory examples single out the difficulties in the topics which they introduce, and supply means of overcoming them. New types of "process examples" are provided in large numbers. Many of these examples prepare the way for the study of geometry.

Mailing-price, 90 cents.

LITTLE, BROWN & COMPANY

34 Beacon Street, Boston **623 South Wabash Avenue, Chicago**

instruction. It will assist the young teacher in getting started right and will keep the experienced one in the right direction. Every teacher should have a copy of this book in her library. C. H. S.

The Thirteenth Year Book of the National Society for the Study of Education. Part II. Plans for Organizing School Surveys with a Summary of Typical School Surveys, by H. L. Smith, Bloomington, Ind., and Charles H. Judd, University of Chicago. 85 pages. 18x22.5 cm. Paper. 1914. 75 cents. The University of Chicago Press.

Comparatively recently it has become the vogue to make investigations or surveys of school systems in cities, counties and states with the purpose in view of determining just what the various conditions may be so that with the information in hand the many phases of the system may be so improved and correlated that the whole system will be made to develop the highest possible efficiency. Any educational institution of whatsoever kind intending to make an investigation of its works should first of all have its directors of the survey become familiar with the contents and suggestions made in this book. There is no better guide to surveys published than this year book. C. H. S.

Textiles, by William H. Dooley, Lowell, Mass., Industrial School. Pages xii+329. 14x19 cm. Cloth. 1914. $1.25. D. C. Heath and Company, New York.

A book written to meet the needs of those folk who are just beginning the study of any phase of the textile trades. A splendid text to use in domestic arts schools and all branches of the cloth maker's trade. Clothing makers will find it extremely helpful in their work. The subject matter is well arranged and the form of language is such that the layman will be interested in reading it. The type is twelve point, the principal paragraphs beginning with heavy bold face type. There are about fifty well selected half-tones showing the many processes through which the various textile fibers pass in being made into cloth. There are sixty-two practical laboratory experiments given which when performed will enable one to understand thoroughly the nature and texture of various fabrics. An index of seven pages is appended. C. H. S.

The Natural History of the Farm, A Guide to the Practical Study of the Sources of our Living in Wild Nature, by James G. Needham, Professor of Limnology, General Biology and Nature Study, in Cornell University. 140 figures. 348 pages. 8 vo. 1913. The Comstock Publishing Company, Ithaca, N. Y.

This is one of the few worth while books of biological nature which may really contribute to the inspiration of the teacher of these subjects. We predict that when it becomes known it will materially alter the character of the teaching of biology (botany and zoölogy) in the high schools of the smaller towns and cities. It is preëminently a book for the country and thus not so well suited to the needs of the teacher in the large city. But it may give many suggestions even for the work in the city.

Space will not allow any real description of the rich contents of the book. It is seasonal and divided into chapters and studies for the Fall, Spring and Summer. Each chapter is accompanied by specific suggestions for study. Some of the chapter headings taken at random will give an idea of the contents: "The Wild Fruits of the Farm"; "The Farm Wood Lot"; "Fiber Products of the Farm"; "Winter Activities of Wild Animals"; "The Fence Row"; "A Spring Brook"; "Calendar of Bird Return"; and many more, equally suggestive of good things. W. W.

THE

School World

A Monthly Magazine of Educational Work and Progress

Price 6d monthly Yearly Volumes 7/6 Net each

THE aim of "The School World" is to provide teachers with information of practical and permanent value. To this end all important changes and developments affecting any branch of education are dealt with by leading educational authorities and experienced teachers.

¶ Each issue contains Eighty Columns of Reading Matter.

¶ The magazine is indispensable to all educational workers who desire to keep in touch with modern methods of education.

LONDON

MACMILLAN AND CO., Limited

NEW YORK: THE MACMILLAN COMPANY

Cussons "Atwood's Machine"

Cussons Patented Ribbon Atwood's Machine is a new form, and furnishes an excellent means of illustrating the laws of falling bodies. A graphic record of the fall is made on the paper strip, connecting the weights. The motion of a single lever allows the weights to drop, and sets the pendulum in vibration. With the use of this machine, results are obtained which cannot be approached in accuracy by any other apparatus. Write for Catalog MM and attractive duty-free prices to

JAMES G. BIDDLE

Sole U. S. Agent

1211-13 Arch St, PHILADELPHIA

When in Philadelphia be sure to visit our Permanent Exhibit of Scientific Instruments.

Hanstein's Skeleton Models and Goniostat

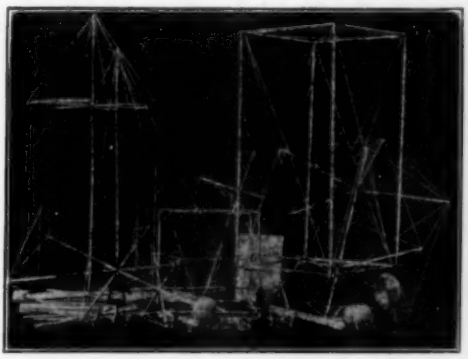
A Teachers' Class-Room Device

in Practical Demonstrations of

Plane and Solid Geometry, Projection Perspective, Drawing, Stereometry, Stereotomy, Axonometry and Crystallography.

"SPECIAL DESIGNS OF MODELS"

Send for circular.



THE CHICAGO MATHEMATICAL SUPPLY HOUSE

(Formerly the Randolph Jones Mfg. Co.)

2019 Mohawk Street, - - - - - - CHICAGO, ILL

Francis W. Parker School Year Book, Volume III. 188 pages. 15x23 cm. 50 illustrations. June, 1914. 35 cents. Francis W. Parker School, Chicago.

This volume, prepared by the faculty of the Francis W. Parker School, Chicago, deals with "Expression as a Means of Developing Motive," or the place of expression in the process of education. It is a distinctive contribution to literature on social education, and portrays vividly certain fundamental phases of education as they have been worked out in this school. Those who have read Volumes I and II of this *Year Book* will welcome the present volume.

The importance of providing adequate opportunities for varied expression on the part of the pupils in connection with every phase of school work cannot be too strongly emphasized. It is the absence of this phase of the educative process in the average school that has made children loathe school and leave it for more interesting activities.

The present volume contains a general introductory article on expression in school work and its intimate relation to motive; an article on children's play as fundamental in education; one on oral reading; one on imaginative writing in school; one on the utilization of the dramatic instincts on the part of children in school work; one on clay modeling; one on metal working; and one on art. In addition to these, a page of references to articles in former volumes of the *Year Book*, dealing with expression, is given.

F. W. P.

ERRATA.

The author of the paper on page 596, October issue, is Roswell Parish, Mechanic Arts High School, Boston.

Fourth line from top of page 599, 200th should be 1000th.

JUST PUBLISHED

Conley's Nutrition and Diet

By EMMA CONLEY, Director of Domestic Science, State Normal School, Oshkosh, Wisconsin.

Price, 60 Cents

This volume for secondary schools is devoted largely to a study of foods—their composition, structure, nutritive value, digestibility, and place in the diet—showing the particular foods which contain the various elements needed by the human body. The composition and functions of the human body are first taken up, followed by a classification of foods according to their elements; digestion; the nutritive and fuel value of foods—digestibility; the practical value of balanced meals; and many specimen menus, with tables showing the quantity of food required for each person and the amount of each element contained in each food. In the latter part of the book, foods are taken up at greater length in groups. Their composition and structure, nutritive value, digestibility, the effect produced by heat, and place in the diet, are brought out in a very helpful manner. Many of the tables used in the book are taken from the bulletins and pub'ications issued by the United States Government.

New York
Cincinnati
Chicago

American Book Company

330 East 22nd Street, Chicago

Please mention School Science and Mathematics when answering Advertisements.